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CONTENTS

The Chemical Industries of America: PROFESSOR CHARLES E. MUNROE 561

Scientific Notes and News 574

University and Educational News 576

Discussion and Correspondence:—
Air Currents in Mountain Valleys: FRANÇOIS E. MATTHES. *The Effect of Asphyxia on the Pupil:* DR. JOHN AUER. *Free Public Museums:* DR. A. R. CROOK. *Facts vs. the Advancement of Science:* BENJ. C. GRUENBERG. *Why Pawlow?* PROFESSOR J. F. ABBOTT. *The Norwood "Meteorite":* DR. G. F. LOUGHLIN 577

Scientific Books:—
Friese's Die Bienen Afrikas: PROFESSOR W. M. WHEELER. *Clowes and Coleman's Quantitative Chemical Analysis:* PROFESSOR E. RENOUF. *Godfrey's Elementary Chemistry:* J. L. G. *Gaupp's Die Normalen Asymmetrien des menschlichen Körpers:* DR. A. HRDLIČKA 580

Scientific Journals and Articles 583

Botanical Notes:—
Papers on Trees; Plant Breeding; General Notes: PROFESSOR CHARLES E. BESSEY 584

Special Articles:—
Artificial Production of Multivoltine Races of Silkworms: PROFESSOR J. F. ABBOTT ... 586

The American Association for the Advancement of Science:—
Section B—Physics: PROFESSOR ALFRED D. COLE 588
Section L—Education: PROFESSOR C. R. MANN 591

The Entomological Society of America: DR. J. CHESTER BRADLEY 597

The Association of Official Seed Analysts: E. BROWN 598

Societies and Academies:—
The Geological Society of Washington: EDSON S. BASTIN. *Section of Biology of the New York Academy of Sciences:* L. HUSSAKOF 598

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THE CHEMICAL INDUSTRIES OF AMERICA[1]

THE topic which you have done me the honor to invite me to address you upon appears on first consideration quite specific, but investigation shows that this is not quite the case. Thus we find the popular idea of a chemical industry to be one producing acids, alkalies, salts, explosives, fertilizers, dyestuffs and extracts, pigments, distillation products and elementary substances like bromine, phosphorus, sodium and others, and the officials of the U. S. Census Bureau in 1880, in fixing a classification, styled in the various censuses "chemical production" or "chemicals and allied products," adopted this popular view.

In discussing this, I have said:[2]

> A reason for the variation in the industries included at the different censuses is found in the very general and indefinite title used, for in the strictest technical sense every material thing is a chemical, and accordingly every industry in which the materials used undergo a chemical change in the process of manufacture, as in the smelting of iron from its ores or the production of leather from a hide, may be considered as a chemical industry. It is evident that if this view of the significance of the title were taken, "Chemicals and Allied Products" would properly cover every manufacture except those like furniture making, machine construction, or textiles, in which the material remains unchanged in composition during the manufacture but is turned, or cast, or woven into other shapes. The popular idea of the term limits its application but admits as chemical industries the manufacture of gunpowder, fertilizers and similar mixtures, whose ingredients

[1] Address delivered before the American Institute of Chemical Engineers at Philadelphia, December 9, 1909.

[2] Bull. 92, Census of 1905, p. 9, by Charles E. Munroe.

undergo no chemical change during the process of compounding the mixtures. It thus became necessary to decide arbitrarily upon the industries to be included. Those so included at the census of 1905 may be divided into the following classes: sulphuric, nitric, mixed and other acids; sodas; potashes; alums, coal tar products; cyanides, wood distillation; fertilizers; bleaching materials; chemicals produced by the aid of electricity; dyestuffs; tanning materials; paints and varnishes; explosives; plastics; essential oils; compressed and liquefied gases; fine chemicals; general chemicals.

These were consequently divided into nineteen different classes which were given separate treatment. The combined statistics for these classes for the censuses of 1900 and 1905 are set forth in the following table, the statistics of these two censuses only being compared because they alone dealt with the same materials:

TABLE I. CHEMICALS AND ALLIED PRODUCTS OF THE UNITED STATES, 1900 AND 1905

	Establishments. Number.	Wage Earners. Number.	Total Wages.	Materials Used. Cost.	Products. Value.
1905	1,786	59,198	$29,515,863	$176,400,680	$282,169,216
1900	1,691	46,700	21,783,335	124,018,044	202,506,076
Increase	95	12,498	7,732,528	52,382,636	79,663,140
Per cent. of increase	5.6	26.8	35.5	42.2	39.3

From Table I. it is observed that there was an increase in every item enumerated, but that not only was the actual increase in the number of establishments less than that of any other item, as was to be expected, but that the percentage increase was less. This indicates that the growth of these industries was rather by increased production of existing establishments than by the creation of new ones. In fact, in a more detailed analysis it was found that in some industries the number of establishments had actually decreased, though each of the other items, as enumerated in Table I., showed an increase.

The greater percentage increase in wages over that of the percentage increase in wage earners shows that the lot of the latter was improved and possibly indicates that a better class of labor was employed, and, since the percentage increase in the number of salaried officials for these establishments was 29.6, while the percentage increase in salaries was but 32.4 it is obvious that the wage earners fared, on the whole, better than the salaried officials.

A wholesome feature to be observed is that while the increase in the number of men employed was 12,104, the increase in the number of women employed was but 413, while there was a decrease of over 10 per cent. in the number of children employed. I speak of this condition as a wholesome one because, outside of the clerical and perhaps analytical work, the duties to be performed in these establishments is essentially man's work.

The greater percentage increase in the cost of materials used as compared with the percentage increase in the value of the products shows the growing necessity of intelligent and careful management and skillful workmanship to prevent waste and to increase yields. This is emphasized by examination of the additional item of miscellaneous expenses which, while less in the total than any of the values given in Table I., showed an increase of 77.2 per cent.

As indicated, the census classification of "Chemicals and Allied Products" which gave the data just discussed is a purely empirical one, and it deals with but a very few of the true chemical manufactures of the United States. It is not possible to derive from the returns, of the various

industries as taken, the data for an exact scientific classification such as has been referred to above. Yet, in order to arrive at a better conception of the application of chemistry in manufacturing industries and its magnitude, we may follow such a scheme of classification as that employed in many chemical technologies, though here again we meet with the difficulties common to classification and we are compelled to include in our data some of the products of purely physical processes, either because these processes are operated collaterally with, or related to, the predominating chemical processes, or else because the products are closely associated with the chemical products. In assembling this data it should be said that in order to compare the data of the different epochs one must first eliminate from the data of 1900 the returns for neighborhood industries, for the census of 1905 was a factory census considering only the results of manufacture as carried out in factories, and not solely for consumption at the point where manufactured as is generally the case with neighborhood industries. The results of this treatment are set forth in Table II.

TABLE II. CHEMICAL INDUSTRIES OF THE UNITED STATES, 1880 AND 1905

	1905	1900	1890	1880
Establishments, number	56,580	53,567	40,451	34,864
Wage earners, average number	1,107,714	943,166	677,123	490,776
Wages, total	$ 575,635,257	$ 438,404,062	$ 305,884,278	$ 176,227,726
Materials used, cost	2,933,660,817	2,215,162,767	1,247,239,582	924,573,773
Products, value	4,716,490,371	3,628,641,475	2,152,490,514	1,357,503,293

Table II., imperfect though it be both in the industries it includes and in those it omits, gives a better conception of the actual magnitude of the industries in which chemical transformations play a part, and which are therefore really chemical industries, than Table I. does, and in so doing it shows the value of the products for 1905 alone to be nearly seventeen-fold greater than is set forth in Table I. The increase is easily accounted for by noting that items such as soap, with a product valued at over $68,000,000; glass over $79,000,000; illuminating gas over $125,000,000; dairy products over $168,000,000; refined petroleum over $175,000,000; paper and wood pulp over $188,000,000; bread and other bakery products over $269,000,000; sugar and molasses over $277,000,000; vinous, malt and distilled liquors over $340,000,000; smelting and refining of copper, lead and zinc over $461,000,000; iron and steel over $905,000,000, and many other items have been added to those embraced in Table I.

The simple enumeration of these items indicates how incomplete the statistics usually presented as those of the chemical industries are and how insufficient the popular conception of the chemical industries is. Yet even the data of Table II. does not present the case in full since all agricultural products, amounting in value in 1900 to $4,717,069,973 are really the results of chemical processes and are therefore the products of chemical industries although not factory products.

As with Table I. so with Table II., the deductions are more readily drawn by observation of the increase and percentages of increase for each item at the various epochs. These have, therefore, been ascertained and are set forth in Table III.

Considering now the data of Table II. and more particularly the increases and percentages of increase set forth for each

TABLE III. INCREASES AND PERCENTAGES OF INCREASES FOR CHEMICAL INDUSTRIES

	1900 to 1905		1890 to 1900		1880 to 1890	
	Increase	Per Cent.	Increase	Per Cent.	Increase	Per Cent.
Establishments, number.....	3,013	5.6	13,116	32.4	5,537	16.0
Wage earners, average number.	164,548	17.4	266,043	39.3	186,347	38.0
Wages.....	$ 137,231,195	31.3	$ 132,519,784	43.3	$129,656,552	73.6
Materials used, cost.....	718,498,053	32.4	967,923,182	77.7	322,665,809	34.9
Products, value.....	1,087,848,896	30.0	1,476,150,961	68.6	795,987,221	58.6

epoch in Table III., while keeping firmly in mind the fact that we are here dealing with two ten-year periods and one five-year period, it is again to be noted that both the actual and percentage increases in the number of establishments are the smallest of all the various increases set forth and that increase for this item for the 1900–05 period is not only actually less than for 1890–1900 and 1880–90, as should be expected, but is proportionately less, thus emphasizing what has been deduced from Table I. as to the increased production of existing establishments.

Likewise the consideration of the data for this larger number of industries extending over a greater length of time shows that not only is the percentage increase in wages nearly as great at the census of 1905 as those for cost of materials and greater than the value of products, but that, while the proportionate increase in the number of wage earners for the 1900–05 period is less than that of 1890–1900, the proportionate gain in wages is greater. In fact, all statistics point to markedly improved conditions for the wage earner in the chemical industries, and to his increased participation in the income from the enterprise. This fact is one to be reckoned on by the chemical engineer in making up his estimate for the cost of a projected enterprise which it is proposed to install.

The statistics of Tables II. and III., on the other hand, do not so markedly support the deductions drawn from Table I. as to the increase in cost of materials used when compared with the increase in the value of the products in 1900–05. However, when we consider the larger items included in these later statistics, such as iron and steel, smelting and refining of copper, lead and zinc, and others, we may each of us recall a variety of labor-saving devices which have been invented and introduced for cheapening the cost of production and handling of the raw materials of these industries, and that the inventions have increased in number and perfection with the growth in magnitude of these industries.

An increase in cost of materials is in conformity with the long-recognized natural law of supply and demand. A modification of this law through which labor may get its fair share of increase and capital may get its fair share of increase while the actual cost may not proportionately be increased has been brought about in recent times through the increase in the magnitude of the unit of demand, or in other terms, the quantity handled. As stated, this has to an extent been rendered possible by the introduction of labor-saving machinery, much of which has been invented in this country.

But in my opinion, and if I read aright the reports of foreign commentators on our chemical industries, in their opinions, the chief modification in the operation of this law has been made in this country through the development of "team work," though the writers style it organization or systemization.

Entering on my fortieth consecutive year

of college teaching, I might, from what has been so persistently dinned into my ears, have been led to believe that "team work" originated in the minds of the college youths who flock to Franklin Field or to the Harvard Stadium. Sitting on the bleachers with practical politicians and presidents, I might be led to suppose that "team work" was an invention of the professional athlete. As a fact the idea of "team work" is a very old one and military in its essence and original application. It is embodied in our national motto. It is commemorated in the "Charge of the Light Brigade." But this older practise, while greatly promoting efficiency, demanded such unreasoning subordination that the private soldier was properly looked upon as but "food for powder," and when this system was introduced into the factory the operator became but "a cog in the machine."

The modification in this plan of "team work" which has been developed to such advantage in the industrial plants of this country has come through a recognition of the great value of individuality and the necessity for its preservation and development, and it has been demonstrated that the higher the intelligence of the individuals who merge their entities with that of their fellows in a common purpose, and the more complete their comprehension of the means used and the end sought, the more successful is the result whether gauged by the quality, or the quantity, or the cost of the output. I am happy to say that the chemist has destroyed the older military idea, even in the army, for by his invention of high-powered smokeless powder he has compelled armies to fight in open order so that each individual must exercise his own powers in attack and defense, and be trained to take the initiative in case of necessity.

Naturally the application of labor-saving machinery and of "team work" is most readily made and yields most efficient results in the production, transportation and handling of the raw materials of our larger industries, and it is in these that we find the smaller proportionate increase in the cost of materials.

American industries, in which the chemical industries are included, have signalized themselves by the introduction of standards, by the introduction of interchangeable parts into mechanisms, by the wide application of labor-saving machinery and by the use of "team work." Yet notwithstanding the vast resources of this country, their ease of access, and the cheapening, by methods such as described, of many of costs of production, the cost of "living," not only here but throughout the civilized world, has steadily increased, and I attribute this largely to the work of the chemist.

At St. Louis, in 1904, I said:

> Technical chemistry, then, invades the domains of economics, of politics and of diplomacy. A striking example of its effects in economics and politics is found in the settlement of the silver question. Gold is a most widely diffused metal. It has, for instance, been shown by assayers at the U. S. Mint at Philadelphia that if the gold in the clay of the bricks of which the buildings of the Quaker City are built could be brought to the surface, the fronts would all be gilded. In the past our processes for the isolation of this metal have been so costly that only the richer ores would bear treatment. Large bodies of low-grade ores which have been discovered and mountains of tailings carrying values were looked upon as worthless, while enormous quantities of copper, lead and other metals containing gold were sent into the market to be devoted to common uses, because the cost of separation was greater than the value of the separated products. Eight years ago, when the "silver question" was made the national issue, while the orators were declaiming from the stump, the chemists were quietly working at the problem in their laboratories and factories. Manhé's process for bessemerizing copper

ores was combined with the electrolytic refining of the product, so that even traces of gold were economically recovered, while the cyanide processes, such as the MacArthur-Forrest, the Siemens-Halske, the Pelatan-Clerici and others for the extraction and recovery of gold from low-grade ores and tailings, were successfully worked out and put into practical operation to such effect that by the cyanide processes alone gold to the value of $7,917,129 was recovered in the United States in 1902, which is more than was ever won throughout the whole world by all methods in any one year up to 1661, and probably up to 1701. The data for other purposes are not at hand for 1902, but the returns for 1900 show that gold to the value of $88,985,218 was recovered in the treatment of lead and copper ores in the United States, of which $56,566,971 worth was recovered in refining. It has but recently been publicly proclaimed in this city of St. Louis, that the "silver question" is settled, and it is settled, but it was settled largely through the efforts of the technical chemist and metallurgist.

With the improvements in methods and diminution in cost of extraction the Pactolean stream has continued to flow in steadily increasing volume[3] until the flood of gold has become so great that its purchasing power has become markedly reduced, and costs, measured in terms of gold, have become markedly greater. With this condition well determined the chemist has again stepped in to increase the cost of living by requiring the application of costly methods of inspection of food, drugs and other articles of consumption; by demanding the elimination of preservatives which permitted the abundance of the harvest being kept till time of need; or the plethora of one locality being sent to the land smitten with leanness; by insisting on the introduction of expensive sanitary arrangements. Pure food laws are the vogue, and all the other needs of man are becoming the subject of special legislation, some wise, but much otherwise. It would prove an interesting exhibit if a statistician were to assemble the actual costs in the administration and execution of these laws in this country alone during the past five years.

I speak with earnestness because I have repeatedly been a participant in these movements, and am even now engaged in an analogous humanitarian enterprise, and I know that a certain result of all such endeavors to improve the lot of man is to put the community to an increased expense.

Having confessed myself, and having found my profession guilty, as charged, I now assert that a chief duty of our profession is to determine methods by which the income may be increased or the costs of living in the land decreased, or preferably both, and I urge as a first measure the advocacy of the policy of preventing any material from leaving the country until it has passed through all processes of manufactures of which it is capable. The meaning of this is evident on inspection of the exports of domestic merchandise prepared by the U. S. Bureau of Statistics, where we find that in 1908 over 885 million dollars worth, or 48.19 per cent., of the total exports consisted of cotton, breadstuffs, meat and dairy products, and coal, much of which had not undergone any degree of manufacture whatever. All this food should have been elaborated in this country into brain and brawn, and the coal made to yield its energy, and these should have been expended here in manufacture. We should further have put into manufactured form the raw materials of other lands.

Inspecting, on the other hand, the table of imports of merchandise prepared by the U. S. Bureau of Statistics, we find in 1908

[3] PRODUCTION OF GOLD

Year	World's Production		Production in U. S.	
	Fine Ounces	Value	Fine Ounces	Value
1878	5,761,114	$119,092,800	2,476,800	$51,200,000
1888	5,330,775	110,196,900	1,604,841	43,175,000
1898	13,877,806	286,879,700	3,118,398	64,463,000
1908	21,378,481	441,932,200	4,574,349	94,560,000

TABLE IV. VALUES OF EXPORTS OF DOMESTIC MERCHANDISE, BY PRINCIPAL ARTICLES AND CLASSES, IN ORDER OF MAGNITUDE IN 1908, DURING THE YEARS ENDING JUNE 30, 1902–1908

Order of Magtude, 1908	ARTICLES	1902	1903	1904	1905	1906	1907	1908	
								Value	Per Cent. of Total
1	Cotton, unmanufactured	$290,651,819	$316,180,429	$370,811,246	$379,965,014	$401,005,921	$481,277,797	$437,788,202	23.86
2	Breadstuffs	213,134,344	221,242,285	149.050,378	107,732,910	186,468,901	184.120,702	215,260,588	11.73
3	Meat and dairy products	199,861,378	179,839,714	176,027,586	169,998,873	210,990,065	202,392,508	192.802,708	10.51
4	Iron and steel, and manufactures of	98,552,562	96,642,467	111,948,586	134,728,363	160,984,985	181,530,871	183,982,182	10.03
5	Copper, and manufactures of	43,820,070	40,594,613	58,119,006	87,564,009	83,178,635	96,600,698	105,872,711	5.77
6	Mineral oils	72,302,822	67,253,533	79,060,469	79,793,222	84,041,327	84,855,715	104,116,440	5.67
7	Wood, and manufactures of	47,779,848	57,743,535	65,428,417	58,002,977	69,080,394	83,349,575	81,521,305	4.44
8	Leather, and manufactures of	29,798,323	31,617,389	33,980,615	37,936,745	40,642 858	45,476,969	40,688,619	2.22
9	Tobacco, and manufactures of	32,772,849	40,444,689	34,683,531	35,491,019	34,218,847	39,113,011	39,463,679	2.15
10	Coal	20,765,461	21,206,498	27,820,323	29,158,322	28,216,376	34,727,762	39,355,759	2.15
11	Animals	44,871,684	34,781,193	47,977,875	46,728,281	49,139,568	41,203,080	34,101,289	1.86
12	Cotton, manufactures of	32,108,362	32,216,304	22,403,713	49.666,080	52,944,033	32,305,412	25,177,758	1.37
13	Agricultural implements	16,286,740	21,006,622	22,749,635	20,721,741	24,554,427	26,936,456	24,344,398	1.33
14	Cars, carriages, etc	9,872,516	10,499,195	10,936,618	10,610,437	17,788,425	20,513,407	22,072,902	1.20
15	Naval stores	11,733,562	12,918,708	16,145,222	16,106 643	20,075,585	21,686,752	21,641,599	1.18
16	Oil cake and oil-cake meal[4]	19,779,142	19,743,711	16,899,257	21,498,085	23,386,218	25,738,471	21,064,974	1.15
17	Chemicals, drugs, dyes and medicines	13,626,887	14,150,493	15,065,682	16,595,523	19,155,989	20,373,036	20,873,155	1.14
18	Vegetable oil	15,308,633	16,234,362	12,618,381	16,632,232	15,906,031	19,550,514	19,633,967	1.07
19	Fruits and nuts	8,719,344	18,057,677	20,678,665	15,606,586	15,274,158	17,588,432	14,338,864	.78
20	Instruments for scientific purposes	5,389,476	7,130,508	8,297,723	8,172,980	10,887,774	13,661,455	11,578,010	.63
21	Fertilizers	6,256,035	6,724,301	7,112,512	7,620,886	8,686,965	8,596,711	10,970,931	.59
22	Paraffin and paraffin wax	8,858,844	9,411.294	8,859,964	7,789,160	8,808,245	9,030,992	8,740,929	.48
23	Seeds	8,027,824	9,455,283	2,583,325	2,557,747	8,912,662	10,094,609	8,683,688	.47
24	Paper, and manufactures of	7,312,030	7,180,014	7,543,728	8,238,088	9,536,065	9,856,733	8,064,706	.44
25	Furs, and fur skins	5,030,204	6,181,115	5,422,945	6,599,222	8,002,282	7,139,221	7,712,890	.42
26	India rubber, manufactures of	4,032.100	4,675,157	5,148,959	5,508,664	6,543,735	7,428,714	7,573,570	.41
27	Fibers, vegetable, etc., manufactures of	4,575,219	5,290,948	6,414,636	6,766,809	8,157,211	8,308,112	7,225,798	.39
28	Books, maps, engravings, etc	3,997,977	4,442,653	4,347,304	4,844,160	5,839,452	5,813,107	6,107,053	.33
29	Grease, grease scraps, etc	2,610,925	2,926,565	3,311,771	3,710,907	4,138,333	5,473,623	5,762,709	.31
30	Fish	6,563,199	6,717,274	7,857,047	6,527,863	7,559,178	5,536,856	5,685,916	.31
31	Household and personal effects	2,570,369	2,652,787	2,615,076	3,146,969	3,595,128	3,928,946	4,782,436	.26
32	Coffee, green	3,209,946	3,295,968	3,656,943	1,966,107	3,483,238	4,692,137	4,314,020	.24
33	Sugar, molasses and confectionery	3,237,329	3,104,653	3,522,805	4,131,707	4,526,334	3,973,360	4,068,357	.22
34	Paints, pigments and colors	2,096,379	2,350,937	2,756,581	3,126,317	3,773,064	3,931,899	4,001,824	.22
35	Vegetables	2,546,287	2,543,488	2,603,374	3,200,860	3,567,127	4,007,833	3,895,294	.21
36	Explosives	2,062,381	2,454,510	2,441,596	2,559,837	3,568,038	4,082,402	3,705,517	.20
37	Brass, and manufactures of	1,930,810	2,000,432	2,557,484	3,025,764	3,474,981	4,580,455	3,701,871	.20
38	Soap	1,630,938	2,452,777	2,499,933	2,670,231	2,781,179	3,806,097	3,407.220	.19
39	Musical instruments	3,694,143	3,381,509	3,230,982	3,144,787	3,168,052	3,256,063	3,371,521	.18
40	Hops	1,550,657	1,909,951	2,116,180	4,480,666	3,125,843	3,531,772	2,963,167	.16
41	Nickel, nickel oxide and matte	1,190,606	864,221	940,558	3,196,622	3,240,544	3,218,862	2,948,058	.16
42	Clocks and watches, and parts of	2,144,490	2,133,529	2,281,195	2,316,414	2,598,441	3,169,272	2,848,725	.16
43	Coke	1,720,457	1,912,459	3,223,233	2,228,442	2,435,604	3,013,088	2,718,385	.15
44	Glucose and grape sugar	2,319,286	2,460,022	2,949,545	3,206,794	3,489,192	3,017,527	2,540,640	.14
45	Glass and glassware	1,960,106	2,150,699	1,978,481	2,252,799	2,433,904	2,604,717	2,505,417	.14
46	Wool, manufactures of	1,512,457	1,722,128	1,987,938	2,035,054	2,119,518	2,239,106	2,219,815	.12
47	Lamps, chandeliers, etc	963,638	1,133,290	1,502,888	1,579,125	1,9[illegible]5,091	1,875,869	1,827,216	.10
48	Spirits, distilled	2,673,273	1,990,091	1,691,467	1,968,767	1,525,225	1,827,757	1,816,287	.10
49	Zinc, and manufactures of	2,017,191	2,346,629	1,710,211	3,085,245	2,780,199	2,143,574	1,606,032	.09
50	Hay	2,580,622	828,483	1,052,705	1,089,505	1,116,307	976,287	1,463,010	.08
51	Marble, stone, and manufactures of	1,761,696	1,465,244	1,589,790	1,283,219	1,466,561	1,433,123	1,248,996	.07
52	Starch	656,705	832,943	1,340,282	1,430,572	1,490,797	1,126,465	1,142,054	.06
53	Malt liquors	1,290,062	1,178,740	854,119	1,012,808	1,116,776	1,215,340	1,020,172	.06
	All other articles	23,761,904	22,557,283	25,770,532	30,732,482	30,998,594	35,784,782	38,463,024	2.10
	Total	$1,355,481,861	$1,392,231,302	$1,435,179,017	$1,491,744,641	$1,717,953,382	$1,853,718,034	$1,834,786,357	100.00

[4] Corn oil cake not included.

TABLE V. IMPORTS OF MERCHANDISE, BY PRINCIPAL ARTICLES AND CLASSES, YEARS ENDING JUNE 30, 1902–1908

Order of Magnitude, 1908	ARTICLES	1902	1903	1904	1905	1906	1907	1908	
								Value	Per Cent. of Total
1	Sugar	$55,061,097	$72,088,973	$71,915,753	$97,645,449	$85,460,088	$92,806,253	$80,258,147	6.72
2	Chemicals, drugs and dyes	57,723,622	64,351,199	65,294,558	64,779,559	74,477,137	82,997,914	73,237,033	6.13
3	Cotton, manufactures of	44,460,126	52,462,755	49,524,246	48,919,936	63,043,322	73,704,636	68,379,781	5.72
4	Coffee	70,982,155	59,200,749	69,551,799	84,654,062	73,256,134	78,231,902	67,688,106	5.67
5	Silk, unmanufactured	42,635,351	50,011,050	46,100,500	61,040,053	54,080,504	71,411,899	64,546,903	5.40
6	Hides and skins	58,011,168	58,031,613	52,006,070	64,764,146	83,882,167	83,206,545	54,770,136	4.59
7	Fibers, vegetable, etc., manufactures of	39,036,364	39,334,521	40,308,837	40,125,406	51,437,581	67,422,557	54,467,572	4.56
8	Wood, and manufactures of	24,445,599	28,746,271	26,984,353	29,564,323	36,532,706	42,969,941	43,527,982	3.64
9	India rubber and gutta-percha, crude	25,652,977	31,004,541	41,049,434	50,729,873	46,035,685	60,206,418	37,753,266	3.16
10	Fruits and nuts	21,480,525	23,726,636	24,435,854	25,937,456	28,915,747	35,867,160	37,354,742	3.13
11	Fibers, vegetable, etc., unmanufactured	31,545,962	34,462,513	37,814,285	38,118,071	39,360,290	42,239,358	35,493,083	2.97
12	Silk, manufactures of	32,640,242	35,963,552	31,973,680	32,614,540	32,910,590	38,653,251	32,717,668	2.74
13	Iron and steel, manufactures of	27,180,247	51,617,312	27,028 312	23,510,164	29,053,987	40,587,865	27,607,909	2.31
14	Tobacco, and manufactures of	17,706,493	20,579,120	20,073,346	22,145,846	26,590,706	30,192,375	27,267,913	2.28
15	Tin, in bars, blocks and pigs	19,461,850	23,618,802	21,486,311	23,378,471	30,932,998	38,117,459	25,295,061	2.12
16	Copper, manufactures of	10,968,948	17,505,247	18,215,442	19,942,511	25,835,502	39,428,687	24,462,663	2.05
17	Wool, unmanufactured	17,711,788	22,152,961	24,813,591	46,225,558	39,068,372	41,534,028	23,664,938	1.98
18	Spirits, wines and malt liquors	15,246,640	17,171,617	16,662,702	17,652,323	19,257,590	22,104,235	20,771,804	1 74
19	Wool, manufactures of	17,384,463	19,546,385	17,733,788	17,893,663	23,080,683	22,321,460	19,387,978	1.62
20	Oils	9,300,198	12,283,957	11,179,442	11,593,520	13,723,948	17,068,777	18,292,393	1.53
21	Furs, and manufactures of	15,623,601	15,301,912	14,763,002	18,306,302	21,855,682	21,884,034	15,918,149	1.33
22	Diamonds and other precious stones	23,348,225	31,479,223	22,964,119	33,313,931	40,247,010	42,278,901	16,642,634	1.39
23	Articles, the growth, etc., of the United States, returned	5,815,628	7,170,573	9,899,470	9,079,124	11,134,912	11,833,983	16,599,766	1.39
24	Tea	9,390,128	15,659,229	18,229,310	16,230,858	14,580,878	13,915,544	16,309,870	1.37
25	Cocoa, crude, and leaves and shells of	6,656,504	7,820,087	8,873,709	8,577,649	8,697,515	13,376,562	14,257,250	1.19
26	Cotton, unmanufactured	11,712,170	10,892,591	8,541,510	9,414,750	10,879,592	19,930,988	14,172,241	1.19
27	Leather, and manufactures of	11,317,785	11,294,167	11,100,215	11,666,233	15,140,926	20.393,533	14,127,347	1.18
28	Earthen, stone and china ware	9,680,156	10,512,052	12,005,014	11,659,723	12,877,528	13,706,790	13,427,969	1.12
29	Fish	8,527,097	8.635,583	9,889,697	10,498,076	11,607,602	12,335,988	12,292,770	1.03
30	Paper, and manufactures of	4,223,125	4,733,036	5,319,086	5,623,638	6,998,761	10,727,885	12,223,058	1.02
31	Meat and dairy products	3,510,696	4,703,536	4,197,466	4,253,414	5,117,054	6,768,432	8,877,183	.74
32	Vegetables	7,039,835	4,581,355	7,008,602	3,983,272	5,092,932	5,728,472	8,289,068	.69
33	Toys	4,023,670	4,232,074	4,977,389	4,964,457	5,887,863	6,993,561	7,206,423	.60
34	Breadstuffs	2,580,295	3,023,160	3,247,503	6,557,347	4,513,667	5,892,968	7,138,214	.60
35	Copper ore	14,003,840	3,385,524	3,466,381	4,892,961	6,727,861	8,296,328	7,057,080	.59
36	Metal, and manufactures of, not elsewhere specified	6,223,383	7,057,202	7,092,125	7,050,118	7,888,565	10,325,446	6,768,637	.57
37	Glass and glassware	6,205,052	7,255,879	6,583,168	5,948,839	7,507,823	7,596,631	6,570,123	.55
38	Seeds	3,252,152	2,831,279	3,587,469	3,457,619	5,388,043	6,404,776	5,371,470	.53
39	Books, maps, engravings and other printed matter	4,133,215	4,323,938	4,529,187	4,589,858	5,599,948	6,451,309	6,036,693	.51
40	Coal, bituminous	5,310,450	10,562,185	5,043,824	3,713,748	4,367,750	4,184,541	5,123,862	.43
41	Fertilizers	2,426,758	3,100,276	3,503,726	4,524,700	4,446,360	5,341,430	4,970,461	.42
42	Hats, bonnets and hoods, and materials for	3,050,478	3,871,278	3,963,043	4,379,473	4,571,184	6,820,259	4,852,548	.41
43	Rice	2,926,921	3,061,473	3,073,430	2,010,966	3,082,203	4,392,146	4,798,553	.40
44	Animals	4,624,531	4,533,845	3,129,609	3,337,454	3,914,382	4,344,282	4,777,459	.40
45	Household and personal effects	2,934,244	2,856,007	3,040,523	3,263,384	3,941,875	3,835,354	4,446,187	.37
46	Feathers and down, crude, not dressed, etc	2,032,566	2,476,659	2,742,018	2,036,791	2,970,260	4,401,131	4,360,721	.37
47	Matting for floors, etc	3,817,866	3,780,050	3,609,795	3,600,088	3,831,436	3,769,202	4,333,044	.36
48	Art works	3,516,536	4,310,315	3,286,262	4,381,324	4,908,782	5,867,265	4,310,767	.36
49	Cork wood, or cork bark, and manufactures of	2,464,934	2,567,580	2,295,138	2,738,319	3,313,306	4,063,982	4,249,006	.36
50	Lead in ore	4,497,360	4,073,099	3.374,661	3,616,476	3,534,876	3,352,534	4,147,720	.35
51	Paper stock, crude	2,770,255	3,015,084	2,900,713	3,796,595	4,374,464	5,580,528	3,675,926	.31
52	Spices	3,685,242	4,815,125	4,366,008	4,583,356	5,188,116	5,113,000	3,591,537	.30
53	Hair, and manufactures of	2,055,536	2,775,084	2,727,062	3,428,404	3,854,349	3,604,599	3,561,012	.30
54	Iron ore	2,362,544	2,351,278	1,593,279	1,670,683	2,728,854	3,360,449	2,949,462	.25
55	Clocks and watches, and parts of	2,460,324	2,672,310	2,990,474	2,966,495	3,105,136	3,593,173	2,922,142	.25
56	Cement	1,478,452	3,607,666	2,052,952	1,355,696	1,394,447	3,778,114	2,100,598	.18
57	Bristles	2,047,331	2,654,604	2,367,301	2,370,498	2,695,746	3,261,877	2,097,777	.18
58	Jewelry and manufacures of gold and silver	2,642,345	2,007,433	2,048,821	1,303,652	1,739,953	1,779,527	1,672,275	.14
	All other articles	50,313,903	57,875,712	52,552,007	57,131,870	73,919,068	88,065,181	74,169,712	6.21
	Total	$903,320,948	$1,025,719,237	$991,087,371	$1,117,513,071	$1,226,562,446	$1,434,421,425	$1,194,341,792	100.00

but a little over 210 million dollars' worth, or 17.87 per cent., of our imports consisted specifically of unmanufactured materials, such as silk, hides and skins, india rubber and gutta percha, wool, cotton, copper, lead and iron ores, and bristles, which would properly go into manufactures here.

We sit back glorying in our country. Its wide extent. Its rich resources. Its teeming millions of independent and self-respecting people. And yet after our fleet has circumnavigated the globe we continue to sacrifice the fertility of our soils to the support of older civilizations and remain content, while ranging ourselves with those nations that live solely on their primary resources, since the "balance of trade" is in our favor. But we as chemists know that this condition can not last. We know that the average fertility of our soil has been growing steadily less and that only by following sound scientific practise can the fertility of the impoverished soil be restored.

The utilization of the soil as a chemical factory is but one of the problems with which the chemist has to deal. That which appeals most nearly to us as chemical engineers is the item that appears as second in magnitude in the table of imports of merchandise and which has held this second place for years, namely, "chemicals, drugs and dyes," for this category embraces those substances commonly known as chemicals, or the products of the "black art." In 1908, we imported 73,237,033 dollars worth of this class of materials or 6.13 per cent. of our total imports. While we exported but 20,873,155 dollars worth, or 1.14 per cent. of our total exports. There was, therefore, a balance of $52,363,878 against us in this item in which the chemical engineers of this country are most nearly concerned. It is true that among these imports are upwards of $15,000,000 worth of crude drugs and dyewoods, and quantities of other crude material, but there are many million dollars worth of substances included here that should have been manufactured in this country. Attention need only to be called to the acids imported to a value of over $1,300,000 to emphasize this fact, for while we are seeking an outlet for our sawdust, we find in this list nearly 9,000,000 pounds of oxalic acid. Or attention might be called to the more than $7,000,000 worth of coal tar products and preparations, not medicinal. Had this been accomplished there is little doubt that our exports of such substances would also have been large. And what is true of the industries commonly called chemical would equally apply to those larger chemical industries not included in the common category.

Another policy we should follow is the promotion of chemical manufactures throughout a larger portion of our great territory. For this purpose I have prepared Table VI., showing by states the locations of each of the 1,786 establishments

TABLE VI. NUMBER OF ACTIVE ESTABLISHMENTS FOR CHEMICALS AND ALLIED PRODUCTS, BY STATES, 1905

	1905		1905
Alabama	27	Mississippi	7
Alaska	1	Missouri	47
Arizona	—	Nebraska	4
California	63	Nevada	3
Colorado	6	New Hampshire	1
Connecticut	40	New Jersey	144
Delaware	13	New York	264
District of Columbia.	3	North Carolina	42
Florida	15	Ohio	128
Georgia	75	Oregon	4
Illinois	89	Pennsylvania	315
Indiana	52	Rhode Island	17
Indian Territory	1	South Carolina	26
Iowa	6	Tennessee	22
Kansas	10	Texas	3
Kentucky	21	Vermont	3
Louisiana	12	Virginia	62
Maine	9	Washington	9
Maryland	50	West Virginia	25
Massachusetts	77	Wisconsin	19
Michigan	52	Wyoming	1
Minnesota	10		

reported for chemicals and allied products at the census of 1905, and I find that seven states or territories, viz., Arkansas, Idaho, Montana, New Mexico, North Dakota, South Dakota and Utah did not at that time possess a single establishment devoted to any of the large number of industries embraced in chemicals and allied products. Oklahoma, New Hampshire and Wyoming each possessed but one, and the District of Columbia, Nebraska, Nevada, Oregon, Texas and Vermont each less than five.

In order to bring this matter of the distribution of the industries manufacturing chemicals and allied products more clearly to your attention I have, through the courtesy of the director of the bureau of the census, had prepared a map of the United States showing the location of the establishments, both principal and subsidiary, manufacturing sulphuric acid, those making explosives, and those engaged in wood distillation, each being a typical industry, and the sulphuric acid industry being generally accepted as of fundamental importance.

From this chart it appears that 13 states and territories, being the seven already named (Arkansas, Idaho, Montana, New Mexico, North Dakota, South Dakota, Utah) with Iowa, Nebraska, New Hampshire, Nevada, Oregon and Wyoming, containing 7,648,000 out of the 76,303,387 inhabitants of the continental United States in 1905, or over 10 per cent. of the whole, did not possess a single establishment devoted to any one of these industries.

Considering sulphuric acid only, which is so important an industry that it has frequently been referred to as an index of the state of civilization of a people, we find that 23 states and territories, namely, the 13 just enumerated, together with Delaware, District of Columbia, Kentucky, Maine, Minnesota, Missouri, Oklahoma, Washington and West Virginia containing 19,562,200 population, or 25.6 per cent. of the total did not possess a single sulphuric acid plant within their borders.

Turning now to the east, we find that 11 out of the 13 original colonies, viz., Connecticut, Georgia, Maryland, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina and Virginia, contained 30,695,000 population, or 40.2 per cent. of the total, and 100 sulphuric acid factories, or 67.1 per cent. of the total number existing in the country. Analysis of the statistics of the separate states shows that the number of these establishments does not follow the population, Georgia, for instance, with about one fourth the population of New York, having twice the number of sulphuric acid factories that New York had.

I am aware that the number of establishments in an industry is an unsafe criterion as to the magnitude or importance of that industry, but this feature has been chosen as lending itself most easily to graphic demonstration. I have therefore assembled, by geographic divisions, in Table VII., data for the quantity of sulphuric acid produced, and we find that inspection of this leads to much the same result as to that which was drawn from the consideration of the distribution of the establishments.

TABLE VII. QUANTITY OF SULPHURIC ACID PRODUCED IN THE UNITED STATES BY GEOGRAPHIC DIVISIONS, 1905 AND 1900

Division	1905	1900
	Tons	Tons
North Atlantic	768,647	734,669
South Atlantic	540,593	520,575
North Central	349,906	153,979
South Central	141,107	87,665
Western	69,184	51,235
Total for United States	1,869,437	1,548,123

All investigations show that there is an enormous extent of fairly well populated area in this country yet awaiting development by the chemical engineer, and I commend this field of service to your attention.

As a field in which costs may be diminished, attention may be called to the saving of waste. So much has been said on this subject that I hesitate to dwell upon it lest I weary you. But I venture to suggest that one remedy for waste, which has not been so markedly dwelt upon as it deserves, is by a change in location, and I take as an example of this the gas industry.

I have long looked upon our present custom of transporting coal long distances to be converted into gas as uneconomic, for a not inconsiderable quantity of coal is burned to provide the energy with which to haul this coal. Not only that but, since the gas constitutes but a very small percentage by weight of the coal, there is a considerable waste in hauling the coke, with its ash, and the by-products. Further, to provide for emergencies, large stocks of coal must be accumulated in advance at the gas works, and as coal, particularly gas coal, begins to deteriorate as soon as it is removed from the mine, there is a very considerable loss going on all the time from this cause. Further, as the by-products or residuals are now purchased in the crude state in relatively small quantities at the different gas works, a large part of their value is consumed in collecting and transporting them to central refineries.

By producing the gas at the mine and shipping it by pipe line the cost of haulage on the coke, with its ash, and crude by-products, is saved. The wastage of coal by weathering is saved. The cost of collection and transportation of the crude residuals is saved. Such coke as is not needed for industrial purposes can be converted in producers into gas which, by means of internal combustion engines, can be used in generating electricity for distribution, and the ash from this coal can be put into the mine for use as a filler in place of coal.

It is evident that gas can, under these circumstances, be made and delivered at a much less cost than is the case at present, though it may be necessary after long travel to enrich it near the point of consumption. Furthermore, the valuable areas now occupied by gas plants in our cities can be given up to more concentrated industries and cheap country lands be substituted for them.

I venture further to suggest that frequently an urgent reason for saving waste is to suppress a nuisance, for I do not hesitate to assert that the existence of a public nuisance is evidence of the existence of an economic waste.

Almost at the outset of my professional life, in 1872, I became involved in the famous Miller's River Nuisance case and it fell to my lot to examine, on behalf of the citizens of Cambridge, Mass., the large slaughtering houses which were believed to be the cause of the nuisance, and to study the operations going on within them. The conditions were very complex and there were a variety of causes which led to the creation and maintenance of this most horrible and most extensive nuisance, but among other causes I found that the slaughtering houses had permitted much valuable blood and offal to escape into the stream and that at that time one establishment alone was pouring into the river, in the water in which it had steamed its hogs, over five tons of gelatinous matter per week, and this was done in ignorance of the existence of this matter in the tank waters.

What I have found to be true regarding matter, I have also found to be true as regards energy, and I cite as an example

the nuisance of "cannonading" in blasting, which is proof in itself of the use of unnecessarily excessive charges of explosives.

But in urging the abating of a nuisance or advising the saving of waste or the conserving of resources, we should not fail to point out that it can usually be accomplished only with added expense, and that a profit can rarely be realized unless the operations are carried out on a quite considerable scale. In fact, it seems to be an economic law that only the rich can really save; that "to him that hath shall be given"; for the poor must pay the price of much subdivision and the consequent cost of much handling and a multiplicity of containers.

In fact, we should make it plain that the advocacy of the saving of waste in manufacture and of conserving our resources necessarily implies the use of great aggregations of capital and the carrying on of large scale operations under a single management. It means the application of methods such as have been applied with great success in the manufacture of hog products or in the refining of petroleum. In dealing with coke at the census of 1905, I found that of the 37,376,251 tons of coal coked in the United States in that census year, only 3,317,585 tons, or 8.9 per cent., were coked in by-product ovens, and I estimated from the yields and values of the by-products which were recovered that had all the coal been coked in by-product ovens there was a possible saving of $37,492,136.[5] This is an enormous amount to save in a single industry in a single year, and if the saving could be made an accomplished fact it would go far toward wiping out that humiliating account against us in our imports of "chemicals, drugs and dyes." But I have never failed to recognize the fact that this could only be accomplished by those controlling large capital, and that it meant the "killing off" of a large number of minor establishments, and I have further recognized the fact that the apparent savings set forth could not be realized until the charges against the more costly plant had been satisfied, nor until the market had been so readjusted that it could absorb this greatly increased output of by-products.

As an example of the commercial advantage resulting from the abating of a nuisance, I cite the instance of Ducktown, Tenn., whose smelters have for decades been notorious offenders. I will not repeat to you the details by which their devastating sulphurous fumes have been converted into valuable merchandise, since they have been so well set forth in current literature, but will simply note that, by report, this saving has resulted in the suspension of a number of the sulphuric-acid works in the contiguous region, and I am ready to believe this report to be true, for I look upon this result as a natural consequence of the operation of a wholesome law in economies.

However, all of the endeavors avail but little so long as we remain a dependent nation, which the quantity of manufactured "chemicals, drugs and dyes" imported by us indicates that we are, and especially while we import over seven million dollars' worth of coal-tar products and nearly two million dollars' worth of ammonium sulphate as we did in 1908, and yet allow 37,000,000 dollars' worth of the by-products produced in the coking of our coal to be wasted. It is evident that there is still a wide opportunity for the employment of the chemical engineer in developing our chemical industries.

I find that I have been led to devote my attention to the chemical industries of the

[5] Bull. 65, U. S. Census of Manufactures, 1905, p. 18.

United States when you have asked me to treat of those of America. I have, however, limited myself not because I consider our country America, but because of the limited amount of information that I have been able to secure relative to the other countries in North and South America. Such as is available for Canada is found in a paper by Dr. W. R. Lang, published in the *Transactions of the Canadian Institute* for 1904, from which it appears that, in 1903, salt was produced in the Dominion to the value of $334,000, and arsenic, in 1901, to the extent of 1,347,000 pounds. Sulphuric acid was produced in Quebec, Ontario and British Columbia, but neither the number of factories, nor the extent of the output is given. However, in treating of the plant at Ontario, which produced about 15 tons of acid per day, it is stated that imported brimstone was used as the raw material, and this in the face of the fact that Canada abounds in pyrites. The wood-distillation industry flourishes in that country, the plant of the Lake Superior Power Company being, it is said, the largest retort plant in the world, but no statistics of production are supplied. Ammonia liquor was produced to the extent of 235,000 pounds of 28° B. strength, a larger part of it being exported. Soap was produced by some 15 concerns employing about 2,000 hands, the value of the product in 1902 being approximately $3,000,000. Glycerine was obtained from the soap lyes, one works being capable of treating 10,000,000 pounds of lye annually. Petroleum refining was carried on at Sarnia, the factory being able to treat 60,000 barrels of crude oil per month. Calcium carbide was made in two works, carborundum and graphite in one. There was a limited manufacture of fine and heavy chemicals. This about completes the tale for Canada.

My efforts to obtain information relative to the Central American and South American states have been less successful, though I have searched the literature and consulted officials from and to these countries. "The Statistical Abstract of Foreign Countries" recently published by Mr. O. P. Austin, chief of the U. S. Bureau of Statistics, covers the exports and imports of these countries for a decade, and it appears to be the only authoritative and detailed report concerning them, yet a painstaking search of the tables of exports for each of these Central American and South American countries shows no other chemical items than borate of lime, iodine and nitrate of soda from Chile; charcoal from British Guiana and Argentina; fermented and distilled liquors from several of the countries, especially from the West Indian Islands; and dyestuffs and extracts from a number of states. Literature relating to the commercial resources and industrial activities of the Pan-American republics, other than the United States, is apparently quite meager, and information regarding their industrial activities appears not to have been collected either by the countries themselves or by students of commerce and industry. It does appear, however, from what information can be obtained, that the resources of these countries are in an undeveloped condition and that these countries present an almost virgin field for development by the chemical engineer.

I have myself attempted to inspire one such development, for at the outset of the undertaking of the construction of the Panama Canal by the United States, I advised that dynamite, which has been consumed in enormous quantities in the excavation work, and the manufactured "raw" materials of its manufacture, be made upon the Isthmus. The easy access

to the nitrate-of-soda deposits of Chile, making but a brief water transportation necessary for delivery, and the existence of pyrites in great abundance in the vicinity of the Isthmus making the production of sulphuric, and hence mixed, acids easy and simple, were a few of the many advantages which would follow the adoption of this plan. But not the least would be the civilizing influence which chemical manufacture always exerts. It is unnecessary to say that up to the present, I have been unsuccessful in my endeavors to introduce chemical manufactures into the Central American states, but I trust that you, who have done me the honor to listen to me, may succeed where I have failed.

Charles E. Munroe
George Washington University

Scientific Notes and News

The funeral of Mr. Alexander Agassiz was held in Appleton Chapel, Harvard University, on Sunday, April 3.

A testimonial dinner to Dr. Charles Frederick Chandler was given at the Waldorf-Astoria on April 2, to permit his former students and associates to express, before his retirement, their appreciation of his forty-six years of service to Columbia University, and his lifetime of devotion to the cause of education and science. It was announced that a lectureship in honor of Dr. Chandler would be endowed by his former students and that the chemical museum of the university would be named in his honor.

Dr. T. Muir, F.R.S., has been elected president of the South African Association for the Advancement of Science for the meeting in Cape Town, the date of which is not yet set.

Dr. Richard Dedekind, professor of mathematics at Brunswick, has been elected a foreign member of the Paris Academy of Sciences.

Sir James Dewar, F.R.S., has been elected an honorary member of the American Chemical Society.

Mr. Frederic A. Lucas, curator-in-chief of the Brooklyn Museum, has been elected a life member of the American Museum of Natural History on account of the practical assistance which he has rendered it and because of his contributions to science.

A dinner was given in honor of Sir John Murray in London on April 5, in connection with the Michael Sars expedition for the exploration of the North Atlantic.

Professor L. A. Wait, head of the department of mathematics at Cornell University, will retire from active service at the close of the present academic year.

Dr. A. R. Ward, director of the State Hygienic Laboratory at Berkeley, Cal., has been appointed chief of the veterinary corps of the Philippine Islands.

At the American Museum of Natural History Dr. E. O. Hovey has been promoted to the curatorship in geology to succeed Dr. R. P. Whitfield, who shortly before his death became curator emeritus. In the department of anthropology, Dr. Pliny E. Goddard has been appointed associate curator, Mr. Harlan I. Smith has been advanced to associate curatorship, Dr. Herbert J. Spinden has been appointed assistant curator and Mr. Alanson Skinner has been added to the list as assistant. A new department of public health has been established with Professor C. E. A. Winslow as curator. A new department of woods and forestry has been established, with Miss Mary C. Dickerson in charge.

Dr. Hermon C. Bumpus, director of the American Museum of Natural History, is making an expedition to Mexico to plan the reproduction of certain prehistoric ruins for structural use in the new hall of Mexican archeology. Mr. Frank M. Chapman, curator of ornithology, accompanied Dr. Bumpus to make studies and collect specimens for a group of Mexican birds.

Chauncey Juday, lecturer in zoology at the University of Wisconsin and expert on the staff of the Wisconsin Natural History Survey, has just returned from a five-weeks trip through Central America, where he studied

the lakes in the volcanic mountain region. He found Lake Atitlan, Guatemala, to be the deepest, being 1,000 feet deep, and the largest, being 24 miles long and 12 wide. It was also the coldest, being, in spite of the tropical climate, but 67 degrees. Its elevation is 5,000 feet above the sea level. Fish and vegetable life he found to be scarce in all these lakes of the volcanic region. In San Salvador he explored Ilopango, 727 feet deep, and Coatepeque, 350 feet deep; and in Guatemala Lake Amatitlan, 110 feet deep. Although Ilopango had two islands raised in it by volcanic action thirty years ago, Mr. Juday now finds no trace of such action there.

DR. E. G. BILL, of Yale University, has received leave of absence for the coming academic year, which he will spend in the study of geometry at the University of Turin.

DR. FREDERICK STARR, associate professor of anthropology in the University of Chicago, who has been conducting anthropological researches in Japan since September, is expected to return to Chicago in the early part of June.

THE University of Minnesota has appointed Professor Thomas G. Lee, director of the institute of anatomy, as its delegate to the Second International Anatomical Congress, Brussels, August 7–11, and to the Eighth International Zoological Congress, Graz, Austria, August 15–20. Dr. Lee sails on April 9 and will spend the intervening time in visiting the principal laboratories in Europe in the interests of the new institute of anatomy about to be erected at the University of Minnesota, at a cost of $200,000.

A SMALL party of geological students from the Massachusetts Agricultural College spent the spring recess in an examination of various sections and other geological features in the Hudson River Valley. The excursion was in charge of Professor C. E. Gordon.

Nature states that the Reale Istituto Lombardo has awarded the following prizes: the mathematical prize for an essay on theory of transformation groups is awarded to Professor Ugo Amaldi, of Modena, for his essay on the determination of all the infinite continuous groups of analytic point transformations in three-dimensional space; the Cagnola prize, relating to miasma and contagion, is awarded to Professor Aldo Castellani, of the hospital for tropical diseases at Colombo (Ceylon). From the Brambilla foundation for industrial prizes, awards have been made to Elia Bianchi, for his system of constructing dwelling houses formed of hollow concrete blocks, and to Renaldo Rossi, for whole-meal and anti-diabetes bread. The Fossati prize is awarded to Professor Giuseppe Sterzi, of Padua, for his two published volumes on the central nervous system of vertebrates.

PROFESSOR MAGNUS-LEVY, of the University of Berlin, has come to America to deliver the three Cartwright Lectures of the Alumni Association of the College of Physicians and Surgeons of Columbia University on April 11, 12 and 13. The subject of the lectures is "Some Phases of the Chemistry of Diabetes." He delivered a lecture before the Harvey Society on April 9 at the Academy of Medicine.

PROFESSOR F. E. LLOYD, of the Alabama Polytechnic Institute, lectured on March 28 before the faculty and students of the University of Alabama on "The Guayule, a desert rubber plant."

PROFESSOR E. L. THORNDIKE, of Columbia University, gave last week at the University of Illinois, five lectures on "Individual Differences and their Causes," under the joint auspices of the College of Literature and Arts and the School of Education. The subjects of the five lectures were: "Measurements of Individual Differences"; "The Influence of Sex"; "The Influence of Race"; "The Influence of Immediate Ancestry"; "The Influence of Training."

A MONUMENT to the memory of Horace Wells, who was the first to introduce the practise of painless dentistry with the aid of nitrous-oxide gas, was unveiled at Paris on March 27 in the Place des États Unis. The monument consists of a bust, supported by a white marble column to which has been affixed a medallion of the physiologist, Paul Bert, who perfected the method of the American

dentist. The ceremony was presided over by M. Dastre, who delivered an address on behalf of the Academy of Medicine.

Professor Robert Parr Whitfield, curator in the American Museum of Natural History since 1877, the author of important contributions to paleontology and geology, died on April 6, at the age of eighty-two years.

Dr. Borden Parker Bowne, professor of philosophy and dean of the Graduate School of Arts and Sciences of Boston University, well known for his works on philosophy and theology, died on April 1, at the age of sixty-three years.

Dr. Harry Walker Jayne, of Philadelphia, an authority on coal-tar products, died on March 7, at the age of fifty-three years.

Dr. Richard Abegg, professor of chemistry at the University of Breslau, was killed, on April 4, in landing after a balloon ascension.

The surgeon-general of the army announces that preliminary examination of applicants for appointment as first lieutenants in the army medical corps, will be held on July 18, 1910, at various army posts throughout the country. Full information concerning the examination can be procured upon application to the "Surgeon-General, U. S. Army, Washington, D. C." The essential requirements to securing an invitation are that the applicant shall be a citizen of the United States, shall be between 22 and 30 years of age, a graduate of a medical school legally authorized to confer the degree of doctor of medicine, shall be of good moral character and habits, and shall have had at least one year's hospital training or its equivalent in practise. The examination will be held concurrently throughout the country at points where boards can be convened. Due consideration will be given to localities from which applications are received, in order to lessen the traveling expenses as much as possible. The examination in subjects of general education (mathematics, geography, history, general literature and Latin) may be omitted in the case of applicants holding diplomas from reputable literary or scientific colleges, normal schools or high schools, or graduates of medical schools which require an entrance examination satisfactory to the faculty of the Army Medical School. Applications must be in possession of the adjutant general on or before June 27. There are at present 123 vacancies in the medical corps of the army.

The Oceanographical Museum at Monaco, established by the Prince of Monaco, was opened on March 29. The different European governments and the principal scientific societies were represented at the ceremony.

The University of Michigan Museum has received from an alumnus, C. A. Hughes, of Chicago, a collection of natural history specimens from British East Africa and an assortment of anthropological specimens from British East Africa, Uganda, Zanzibar, Zululand and other countries on the east coast of Africa. The mammals include: eland, topi, Jackson's hartebeest, wildebeest, bushbuck, waterbuck, wart hog, Coke's hartebeest, impala, Grant's gazelle, oribi, oryx, Petersi, steinbuck and Thompson's gazelle. Mr. Hughes was a member of the W. D. Boyce African Expedition, which invaded the interior of Africa with balloons and box kites for the purpose of making aerial pictures of game in the wild state, getting a photographic record of the topography of the country and pictures of the natives in their homes, and at work, hunting, play, etc. Besides Mr. Boyce, who personally led the expedition, and Mr. Hughes, there was a large staff of photographers. The expedition was entirely successful.

Mount Sinai Hospital, New York City, announces the establishment of a second fellowship in pathology which will be known as the Eugene Meyer, Jr., fellowship. The income of the new fellowship, like that of the George Blumenthal, Jr., fellowship, established in 1908, is $500 per annum.

UNIVERSITY AND EDUCATIONAL NEWS

The new general engineering building of Union College will be formally opened on April 28.

MR. MILTON C. WHITAKER, M.S., general superintendent of the Welsbach's Company's works, has been appointed professor of industrial chemistry, at Columbia University, to the vacancy caused by the retirement of Professor Charles F. Chandler. Dr. Marston Taylor Bogert has been appointed to succeed Dr. Chandler as head of the department of chemistry.

AT Harvard University, Dr. H. W. Morse, in physics, and Dr. L. J. Henderson, in biological chemistry, have been promoted to assistant professorships. Dr. W. R. Brinckerhoff has been appointed assistant professor of pathology and Dr. S. B. Wolbach, assistant professor of bacteriology.

WALTER T. MARVIN, A.B. (Columbia), Ph.D. (Bonn), preceptor in Princeton University since 1905, has been appointed professor of mental philosophy and logic in Rutgers College.

DR. ARTHUR WILLEY, F.R.S., director of the Natural History Museum at Colombo, Ceylon, and marine biologist to the Ceylon government, has been appointed professor of zoology at McGill University. Dr. Willey, a graduate of Cambridge, acted for some years as tutor in biology in Columbia University.

DISCUSSION AND CORRESPONDENCE

AIR CURRENTS IN MOUNTAIN VALLEYS

TO THE EDITOR OF SCIENCE: Mr. Varney's interesting account of the control of cliff shadows on air currents observed in the valleys of the Canadian Selkirks, which appeared in a recent issue of SCIENCE, prompts the following report of some facts of a similar nature noted in the Yosemite Valley.

The lay and configuration of the steep-walled Yosemite trough are such that at no hour of the day, even in mid-summer, are its two sides fully sunlit throughout: there are always cliff shadows here and there; while some dwindle, others grow. The effect of this alternation of light and shadow upon the air movements along the valley sides is most marked, indeed it fairly forces itself upon one's attention when traveling on any of the zigzag trails that lead up out of the valley. On a sunlit slope the dust from the horses' feet floats slowly upward in a golden cloud that accompanies the ascending traveler in a truly exasperating manner. On a shaded slope, the dust cloud pours at once over the edge of the trail, so that parties descending rapidly from zigzag to zigzag constantly meet their own dust wafting down upon them from above. Obviously, the logical thing to do, in order to have a dust-free journey, is to time one's ascent for an hour when the trail is in shadow, and one's descent for an hour when the trail is sunlit. This principle, after it was once understood, was indeed deliberately put in practise by the writer on all occasions when the choice of hour mattered little otherwise—always with the desired result. Some trails, like that to the Yosemite Falls, lie as a rule partly in sun, partly in shadow, and on them the trips were arranged so as to avoid the dust on those stretches where experience had shown it to be densest.

In the Yosemite Valley, as in many other mountain valleys, there is further a pronounced general air movement lengthwise through the trough, proceeding up valley in the day time and down valley at night. The rhythmic regularity with which it reverses in the early morning and in the late afternoon, was made strikingly manifest during the summer of 1905, when severe forest fires near the lower end of the valley sent up a generous volume of smoke in the otherwise pure atmosphere. Every morning the valley was clear, having been swept out, so to speak, by the nocturnal down-valley current, and the pall could be seen floating off to the southwest, down the Sierra flank. But, as the shadows in the valley trough began to shorten and progressively larger areas became insolated, a moment would soon come when the warm up drafts gained the upper hand, and the up-valley current would be inaugurated. Then, the smoke would creep up the valley, becoming denser by degrees, until by nine or ten o'clock one could scarcely see across from rim to rim. This condition would prevail all day, until with the lengthening of the shadows

in the late afternoon, the second reversal would be brought about. The down-valley current would then set in, taking the smoke back with it.

To the writer who was at the time engaged in the topographic survey of the valley this daily smoke invasion was, it may be imagined, a source of no little annoyance; for, while it lasted, it precluded all long-distance graphic triangulation across the valley, the only means whereby the host of peculiar cliff details, so characteristic of the Yosemite Valley, could be located. Nor was it a matter of a day or two; with a provoking regularity rendered possible only by the general absence of disturbing winds and cloudy skies, typical of the region, it continued for four long months with scarce an interruption.

No doubt intimately related to the rhythmic reversals of the lengthwise air current is the period of placidity of Mirror Lake. The surprised and usually vexed tourist who finds he must get up an hour before sunrise if he wishes to see the mirror at its best, little suspects that what he has undertaken to do really amounts to keeping an appointment with the early-morning reversal of the air current, and that punctuality on his part is vital because of the almost momentary briefness of the phenomenon. Yet such is actually the case. The stillness of the water surface sets in as the down-valley draft dies out; but as soon as a sufficient amount of cliff surface has been insolated in Tenaya Canyon, the upward movement becomes general, and a faint tremor once more steals over the lake. That its placidity is less perfect with the afternoon reversal is probably due to the relative suddenness with which that reversal takes place and the almost immediate strength of the downward currents in a narrow steep-walled chasm like Tenaya Canyon.

There is a certain appropriateness, finally, in likening the nocturnal down-valley current to a stream. For not only does it follow the bottom of the valley trough as a channel, but it also receives tributaries from the side valleys. In the case of the Yosemite Valley, the parallel is the more complete, as each tributary air current literally plunges, water-fall-like, from the mouth of its hanging valley. Few visitors to the valley, probably, are aware of the existence of these—shall we call them "air-falls"?—nevertheless they are by no means imaginary, as one may readily find out to his satisfaction by ascending either the Yosemite Falls trail or the Nevada Falls trail in the evening. The writer had occasion to do so many times in returning to his high-level camps above the valley, and the unpleasant memory of the chilling down drafts that poured upon him on these evening trips has not yet lost its vividness.

François E. Matthes
Washington, D. C.

The Effect of Asphyxia on the Pupil[1]

Over a year ago I reported[2] that CO_2 gas produced a practically maximal constriction of the pupil, both in the intact frog and in excised bulbi, and I stated that this behavior of the frog's iris was interesting because asphyxia in mammals produces chiefly dilatation. This latter statement gave surprise to Drs. C. C. Guthrie, F. V. Guthrie and A. H. Ryan and they write in a recent issue of Science[3] that "in all animals observed, only momentary or no dilatation of the pupil occurs during the first stage of rapid asphyxia (. . .), and that as a rule a *very marked constriction* of the pupil occurs during this stage." It must be noted that these authors speak only of the *first* stage of asphyxia, the stage of hyperpnœa, and do not mention at all the second and third stages, where true asphyxia has developed. Had they pushed their experimental investigations a little farther, they would have found the marked dilatation of the pupil which occurs in mammals during the second and third stages of asphyxia. This well-known dilatation of the pupil is more pronounced and

[1] A reply to Drs. C. C. Guthrie, F. V. Guthrie and A. H. Ryan. (From the department of physiology and pharmacology of the Rockefeller Institute.)

[2] *Amer. J. of Physiol.*, 1908, XXIII., p. xvi; see also report of a demonstration, *Proc. of the Soc. for Exp. Biol. and Med.*, 1908, VI., p. 49.

[3] Science, March 11, 1910, XXXI., p. 395.

more lasting than the transitory initial pupillary constriction, and for this reason I said in my brief notes that the mammalian pupil shows "chiefly" dilatation during asphyxia.

From the above it will be seen that there was no occasion for the surprise nor the original communication of Drs. Guthrie, Guthrie and Ryan.

JOHN AUER
THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

FREE PUBLIC MUSEUMS

IN an interesting note in the February 11, 1910, copy of SCIENCE, Mr. Baker calls attention to the commendable policy of the Chicago Academy of Sciences, while commenting on Mr. Ward's statement of the liberal practise at the Milwaukee Public Museum, of having its museum open freely to the public, and shows that while the Milwaukee institution has been free to the public since 1905, the Chicago Academy of Sciences has been following that plan since 1894.

The Illinois State Museum of Natural History has been accessible to the public without charge for the last half century, thus preceding the afore-mentioned museums in this good work by many years. It now remains to hear from some museum which has been free to the public for a century.

Doubtless the time is speedily approaching when museums will be as free and as accessible as our libraries. The hours during which museums are commonly open, from nine to five, should doubtless be extended in order that working people might be accommodated. With the disappearance of the candle light period there is no insurmountable obstacle toward making the museums as attractive during the evening hours as during the day time.

The Illinois State Museum is visited possibly more largely by the people from the surrounding villages and towns than by the citizens of Springfield. Previous to the last four months the number of visitors were simply estimated, but during the last three months count has been kept and the number has averaged about 1,500 monthly. The highest attendance was recorded during the first week in last October, when within five days 11,866 people visited the museum.

When the state properly cares for this institution which has had so long and useful a history, and which has a mission of untold value to perform, it will be extensively patronized and amply justify the expenditure necessary to make it one of the most valuable of the free public institutions in the state.

A. R. CROOK

FACTS VS. THE ADVANCEMENT OF SCIENCE

IN his vice-presidential address before Section L, Professor Dewey took as his text the failure of science teaching to fulfill the prophecies of its priests; and he referred this failure to the custom of teaching science as information rather than as that method of using the mind which is necessary for the manufacture of knowledge. Both elements are essential parts of science; it is, however, important that we keep clearly in mind which aspect we mean when we speak of science-teaching, or of the advancement of science.

We all know that there can be no true science that does not rest solidly upon facts. But the thought must often occur to many of us that there is some danger, especially among the younger scientists, that we may become obsessed with an exaggerated sense of the value of facts as such. Is there not too much emphasis laid by many professors in charge of research students on the mere accumulation of observational, statistical or experimental facts, with too little attention to that side of science which concerns itself with those analytical and synthetic processes that convert facts into valuable ideas? It seems to me that this latter kind of work needs at the present time at least as much encouragement as the other. Of course, there is the possibility for "thinking" to degenerate into profitless speculation; but we are certainly as much in need of the results of thinking about the facts already accumulated as we are of more facts.

It was especially noticeable at the meeting of the association that the younger men pre-

sented facts to the various sections, while the older men gave a larger share of their attention to the analysis of facts accumulated by others, combining results from various sources for the bracing or demolishing of hypotheses. It may be claimed that the right to speculate has been earned by the professors through years of hard work, and it is true that judgment comes with years. But the question occurs to me whether what may after all be a rarer kind of ability is not unduly discriminated against by the custom of demanding of all candidates for higher degrees in science "contributions" that are essentially accumulations of new data. Do we not need to recognize that there are at least possible "contributions" of value for the advancement of science that do not consist chiefly of new facts?

Benj. C. Gruenberg
DeWitt Clinton High School,
New York
January 1, 1910

WHY PAWLOW?

To the Editor of Science: In the interesting address of Professor Howell's published in Science of January 21, 1910, I note a reference to the work of "Pawlow" on enterokinase. Perhaps it is too late in the day to protest against this spelling, but it seems to the writer that even should our physiologists concede their science to be "made in Germany," certainly our language is not. There are certain obvious rules for the transliteration of Russian names that have been in effect since such transliteration began to be done. But of late there appears to be a tendency to ape the Germans in this regard. Vladivostok now masquerades on many maps as Wladivostok. But if Pawlow, why not "Saratow," or "Orlow" or "Trepow" or "Popow"? Even *Minerva* which no one ever accused of being un-Teutonic in its make-up, uses the spelling Pavlov throughout. What reader of contemporary history would recognize the name of the famous Russian diplomat, Pavloff, if he read that one Pawlow was some time minister to Korea? Surely our orthography is bewildering enough as it stands without wantonly importing foreign absurdities into it.

J. F. Abbott

THE NORWOOD "METEORITE"

To the Editor of Science: Professor Very in his second article on the Norwood "meteorite" (Science, March 18, 1910, pp. 415–418) states that I helped him identify some of the minerals in thin section. I did identify the minerals, but, as is apparent to any petrographer, I am in no way guilty of the extinction angles recorded by Professor Very, or of the novel method of determining the composition of the feldspar. The feldspar is labradorite, but I did not attempt to find its exact composition.

G. F. Loughlin

SCIENTIFIC BOOKS

Die Bienen Afrikas nach dem Stande unserer heutigen Kenntnisse. Von Dr. H. Friese. Zoologische und Anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Südafrika ausgeführt in den Jahren 1903–1905, mit Unterstützung der Kgl. Preuss. Akad. d. Wiss. zu Berlin von Dr. Leonhard Schultze. 2 Bd. 475 pp., 2 pll., 19 charts and 1 text. fig. Jena, Gustav Fischer. 1909.

In this monograph the noted melittologist, Dr. H. Friese, has brought together practically all that is known concerning the Ethiopian apifauna. The region covered is Africa south of a line drawn from Senegal to Abyssinia. In all, 777 species of bees are enumerated from this vast area. Fifty-three of these are described for the first time, and of the remainder the original descriptions are reproduced. The introductory portion of the work will interest the student of geographical distribution, since it contains a number of maps showing the ranges of some of the more characteristic genera of bees, both in Africa and in other parts of the world. The bees of Madagascar are not considered, because they are mostly of peculiar genera and have been adequately described by H. de Saussure in his

contribution to Grandidier's great work on the fauna and natural resources of that island. The numbers given by Friese for the apifauna of various countries are worthy of note. Germany is credited with 440 species, Hungary with 510, Tyrol with 380, Great Britain with 200, Sweden with 212, Algiers with 413. The number of described species for the world is estimated at 8,000, of which 2,000 belong to Europe alone. Thus it will be seen that the Ethiopian region, though it may actually possess as many as 1,000 to 1,200 species, according to Friese's estimate, has a much poorer apifauna than Europe. This bears out the author's statement that bees are not really tropical insects, but have their optimum area of speciation in the north temperate zone. An examination of the Ethiopian bees shows, moreover, that a very large proportion of the genera and species must have come originally from the palearctic region, the southernmost portion of which is formed by the Mediterranean and part of the Red Sea littoral of Africa. According to Friese, the Ethiopian region has received its palearctic component by immigration "from Egypt, which is purely palearctic, like Algiers and Tunis, over Sudan-Abyssinia to the Kilimandjaro and Meru, where we still find on the mountains at altitudes of 2,500 to 3,000 m. some purely European forms of *Halictus* and a species of *Andrena* (*A. africana*) which is very similar to *A. helvola* of Central Europe." There is a possibility that a similar immigration has taken place from the Mediterranean littoral into the Congo basin along the west coast of the continent.

The palearctic origin of the great bulk of the Ethiopian apifauna is furthermore attested by the fact that though it comprises many cosmopolitan and European genera such as *Xylocopa, Nomia, Anthophora* and *Megachile,* often represented by species that have a striking African facies, it nevertheless contains very few genera that occur nowhere else. As such endemic genera Friese cites *Polyglossa, Patellapis, Fidelia, Meliturgula* and *Eucondylops,* each of which seems to have a very restricted range. *Meliturgula* stands between the genera *Panurgus* and *Meliturga; Polyglossa* and *Patellapis* are primitive forms, the former belonging to the Colletine, the latter to the Halictine subfamily. *Fidelia* is a genus unlike any hitherto described in that it presents a singular mixture of Gastrilegid and Podilegid characters. *Eucondylops* is based on a parasitic species (*E. konowi*) which Dr. Hans Brauns discovered in the nests of the remarkable bees of the genus *Allodape.* This latter genus ranges over the Indo-Malayan region, Sunda Archipelago, New Guinea and a limited portion of eastern Australia, but it is represented by the greatest number of species and individuals in the southern half of Africa, which is therefore to be regarded as its true home. Brauns, as quoted by Friese, found that the species of *Allodape* "do not make cells and provision them like other solitary bees with food for the individual larvæ, but that the eggs and larvæ in all stages of development, the pupæ and callow bees are all found together simultaneously in the same cavity of a hollow twig, which may attain a length of 12 cm. The larvæ, which are unique among bees in having extraordinary foot-like appendages, with which they hold the food that is given them, are fed till they mature." These bees are, therefore, truly social and breed and fly throughout the year along the warm coast of Cape Colony. It is interesting to note that the parasitic *Eucondylops* is very similar to its host *Allodape,* so that it is to be regarded as having been derived from this genus. This kind of phyletic relationship has been noted between many other parasitic bees and their hosts, and we are now coming to believe that many parasitic ant genera are also derived from the genera of their hosts.

Friese shows that the Ethiopian apifauna is very rich in certain genera, which are not so well represented in many other parts of the world. Thus he records 162 species of *Megachile* and 61 species of *Xylocopa.* Other widely distributed genera, however, like *Andrena* and *Osmia,* are very poorly represented.

The social bees of the Ethiopian region comprise 29 species of *Trigona,* the honey bee and four of its subspecies and varieties (*Apis mellifica, A. unicolor-adansoni, unicolor-in-*

termissa, unicolor-friesei and the typical *unicolor*). The bumble-bees (*Bombus*) are absent from the Ethiopian region, though they are known to occur in tropical South America.

W. M. Wheeler

Quantitative Chemical Analysis, Adapted for use in the laboratories of colleges and schools. By Frank Clowes, D.Sc. (London) and J. Bernard Coleman, A.R.C.Sc. (Dublin). Eighth edition. Philadelphia, P. Blakiston's Son & Co. 1909. Pp. 565. $3.50.

This is a new edition of a well-known and very popular book. The first edition appeared in 1891, the seventh in 1905. This was reprinted in 1907 and again in 1908, and here is a new edition. What is the reason for this popularity? We find it on comparing this with other manuals, which are as a rule either general or special, those of the general type giving few special or technical methods, and those of the special type dealing with a single branch of analysis. In the present book the authors begin with very thorough instruction in general analysis and pass on to specialties, such as the analysis of gas, water, milk, butter, tanning materials, oils and fats, assaying, iron and steel, etc.

This comprehensive task is well done in this edition in 565 closely printed pages, by omitting matters theoretical, and thus gaining space. The directions for work are so clear and comprehensive that an isolated analyst should be able to overcome any difficulties with its help. For example, 10 pages are given to a thoroughly illustrated, very detailed but empirical treatment of the subject of the balance and weighing. Treadwell in his analytical chemistry gives also 10 pages to the subject, but half this space is given to mathematics and theory.

In brief the present volume will appeal less to the university-trained chemist, who has access to a library of books on analysis, than to the great number of analysts with only college or technical school training who need a well-written comprehensive book, which simply tells them what to do and how to do it.

Among the new methods described in the preface may be mentioned additional methods for the determination of melting and boiling points, for the electrolytic estimation of metals, for the volumetric estimation of hydrogen peroxide, formaldehyde, silver, tin and antimony in alloys and various new technical processes including the use of the bomb-calorimeter in coal valuation, and a new section on oils, fats and waxes to which Professor Lewkowitch has contributed.

E. Renouf

Elementary Chemistry. By Hollis Godfrey, Head of the Department of Science, Girls' High School of Practical Arts, Boston, Mass. Longmans, Green & Co. 1909. Pp. 456.

In the preface the author states that,

> Four ideals have governed the writing of this book. The author has desired to obtain simplicity; to reach the understanding of the student; to rouse the pupil to a realization that the science of daily life is identical with the science of the school room; to include all the essential facts and theories which could be rightly assimilated in one year's work in elementary chemistry. . . . No book which is a mere encyclopedia of facts arranged without reference to their teaching value can produce a maximum of effect. . . . It has been a constant purpose to bring forward wide-reaching general truths in the form in which they would most effectively impress the student.

In this book the author has followed a different path from the usual one and has produced a work which has much to commend it for the purpose for which it is evidently intended. Instead of confining himself to a rather detailed study of a few of the simple substances and preparing the way for a more advanced course, the author has had in mind the needs of those who will have no further opportunity to study this subject and has covered in a very general way the more important points in the fields of both inorganic and organic chemistry, emphasizing especially the application of this science to daily household life. Owing to the fact that this book would probably be used by students more advanced than those who would take an elementary

course as a preliminary to a more advanced one, the subjects can be treated in a more general and advanced form without, however, smothering the general principles in a multitude of details. One peculiar feature of this book which would probably attract the attention of a reader is the unusual method of introducing various subjects by what might be called a poetical reference to some action in the world at large as a basis to explain some chemical fact or hypothesis. While this appears, to the chemist who has been trained to reason on the basis of observed facts and to keep away as far as possible from unprofitable speculation, to be an unscientific method of treating the subject and one usually more suitable for primary grades, it may have its value, just as a study of models enables one to grasp more clearly the conception of stereochemistry and the configuration of molecules. On the whole, therefore, the reviewer considers that this book should be of value in introducing a class of girls to the part which chemistry plays in the affairs of the world surrounding them. J. L. G.

Die Normalen Asymmetrien des Menschlichen Körpers. By Professor Dr. E. GAUPP. Pp. i + 59, mit 8 Textfiguren. Jena, G. Fischer. 1909.

This little but useful volume forms a fourth part of a "Collection of Anatomical and Physiological Publications" written by Professors Gaupp and W. Nagel.

The present work is to a large extent a continuation of Professor Gaupp's former study concerning the right-handedness of man (No. I. of the same series of publications). It summarizes in a somewhat detailed manner the various observations recorded in anatomical and anthropological literature on such asymmetries of the different parts of the human body which are not due to disease, and at the same time it presents a thorough critical consideration of the many causes of these various inequalities.

A large part of the brochure is devoted to the asymmetries of the spine and to those of the limbs. The treatment of the inequalities in the different other parts of the osseous system is less comprehensive, and there is a lack of individual investigations by the author. Notwithstanding this the work will be very useful for reference to the student of the subject with which it deals, and will be further valuable by its large bibliography.

There could, perhaps, be found some fault with the term "normalen" in the title, for strictly speaking there are no *normal* asymmetries; but the author employed this term in want of something more expressive to denote that he is not dealing with the effects of pathological conditions. A. HRDLIČKA

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VII., No. 4, issued March 25, contains the following: "The Purin Ferments of the Rat," by Alice Rohdé and Walter Jones. Investigation of extracts of the tissues of rats failed to demonstrate either adenase or xanthoöxidase. Rats' urine, however, contains uric acid. The origin of this uric acid must be attributed either to the action of purin ferments *in vivo* which do not exhibit themselves in organ extracts or to processes which do not involve the known purin ferments. For the latter explanation, much experimental proof exists. "On the Salts of Cytosine, Thymine and Uracil," by Victor C. Myers. A description of the preparation and some of the properties of the sodium, potassium, mercury and lead salts of thymine and uracil. "The Presence of Iodine in the Human Pituitary Gland," by H. Gideon Wells. Analysis of human pituitary glands taken from subjects who had not received iodides while in the hospital failed to show iodine in the gland: similar analyses of glands from subjects who had received iodides revealed iodine in the pituitary gland. Hence the normal presence of iodine in the gland is unproved. "A Note on the Physiological Behavior of Iminoallantoïn and Uroxanic Acid," by Tadasu Saiki. Elimination of purins in the urine is unaffected, excretion of oxalic acid is increased by the administration of either of the abovementioned substances. "Nylander's Reaction

in the Presence of Mercury or Chloroform," by M. E. Rehfuss and P. B. Hawk. Neither mercuric chloride nor chloroform interferes with Nylander's test for sugar performed in the manner described by these authors. "A Study of Nylander's Reaction," by M. E. Rehfuss and P. B. Hawk. A study of various methods of performing the test, its delicacy, the effects of temperature and the influence of a variety of substances upon it (drugs and urinary constituents). "Effects of Soluble Salts upon Insoluble Phosphates," by J. E. Greaves. Various salts such as sulphates, chlorides, nitrates of sodium, calcium, ammonium or magnesium may increase the solubility of the insoluble phosphates and so indirectly affect the growth of plants.

BOTANICAL NOTES

PAPERS ON TREES

Three papers upon the hawthorns (*Crataegus*) have come to hand during the past few months. The first by W. W. Eggleston—"The Crataegi of Mexico and Central America" (*Torrey Bull.*, 1909)—describes the wild species and varieties of these countries, ten in number, of which four species and two varieties are here named for the first time. The author remarks that "the genus *Crataegus*, south of the United States, seems confined to the tablelands of Mexico, and southward through the highlands of the Andes. In Mexico the fruit is of much economic importance, being often found in the markets, and the trees are guarded as carefully as other fruit trees are with us."

The same author in a later number of the *Torrey Bulletin* under the title "New North American Crataegi," describes three new species from (1) Texas, (2) North Carolina, eastern Tennessee and southern Virginia and (3) Montana.

Professor Sargent has been studying the "American Crataegi in the *Species Plantarum* of Linnaeus" (in *Rhodora*, 1909) in the Plukenet Herbarium (British Museum), and in the Linnaean Herbarium. *Crataegus viridis* is identical with *C. viridis* of the southeastern United States. *C. crus-galli* can not certainly be identified with any of our species. Of *C. tomentosa* he says "it is not possible to guess even at the plant described by Linnaeus" under this name. *C. coccinea* is in such confusion that Professor Sargent abandons the name, and substitutes for it the name *C. rotundifolia*, var. *pubera*.

Ivar Tidestrom's "Notes on Populus, Plinius" (in *Midland Naturalist*, 1909) attempts to distinguish *Populus alba*, *P. canescens* and *P. alba bolleana*. His discussions and descriptions are made plainer by two plates.

Before leaving Vermont for Wisconsin Professor L. R. Jones completed with the aid of F. V. Rand a most useful paper on "Vermont Shrubs and Woody Vines" (Bull. 145, Vermont Experiment Station), including figures and descriptions of the smaller woody plants of his state. He enumerates 135 species, and this does not include any species of *Crataegus*, this genus being passed over with only a characterization of the "groups." The excellent and life-like cuts (by Mary Robinson) enable one to follow the text descriptions very easily. We wish here to record our conviction that bulletins of this kind, although not "agricultural" in the narrower sense, are very properly included among the publications of the Agricultural Experiment Stations, since they bring to all who are interested in trees and shrubs much information which must lie at the foundation of many "practical" investigations.

Professor Shimek discusses "A Hybrid Oak" (in *Proc. Iowa Academy of Sciences*, 1909) and by comparisons and figures shows it to be pretty certainly a hybrid of *Quercus imbricaria* and *Q. palustris*.

Allied somewhat remotely to the foregoing papers is H. H. Bartlett's article on "The Submarine Chamaecyparis Bog at Woods Hole, Massachusetts," in *Rhodora*, December, 1909. A photograph shows well the roots of trees that once grew at levels now covered at high tide.

Professor Shimek read a paper on "The Relation of Forestry to Engineering" early in

1909 before the Iowa Engineering Society (published in the *Proceedings* of the Society) which is a vigorous defense of the contention of the foresters that forests conserve the rainfall in such a manner as to materially affect stream flow. Beginning as a defense, the writer rapidly pushes his discussion into a smashing criticism of recent statements made in certain quarters as to the inefficiency of forests in holding back and lessening floods. The paper should be widely read at this time when concerted assaults are being made upon the efficiency of the forest cover.

Here we may notice Professor Bray's bulletin on "The Mistletoe Pest in the Southwest" (Bull. 166, Bureau of Plant Industry, U. S. Department of Agriculture). From it we learn that the American mistletoe (*Phoradendron flavescens*) extends through the southern states across Texas, New Mexico and Arizona to southern California, thence northward in the coast region to Oregon and Washington. In the east its northern limit is New Jersey, southern Pennsylvania to southern Illinois, Missouri and eastern Oklahoma. In Texas it attacks species of *Hicoria, Quercus, Ulmus. Celtis, Toxylon, Morus, Sassafras, Acacia, Prosopis, Gleditsia, Xanthoxylum, Melia, Sapindus, Nyssa, Diospyros, Fraxinus* and *Tecoma*. In commenting on this matter the author says: "It is a question whether any tree is wholly immune to attacks from the mistletoe." Much space is given to a discussion of the eradication of the pest. Two plates and several text illustrations add to the value of the bulletin.

Professor F. J. Phillips makes a valuable contribution to our knowledge of a peculiar injury to forest trees—namely, that due to hail-storms, in a recent paper—"Hail Injury on Forest Trees" (*Trans. Acad. Sci. St. Louis,* XIX., 3). By means of photographs the author shows the extent of the injury (often very great) to many kinds of trees. The direct injury is often supplemented by the advent of boring insects and wood-destroying fungi. Catalpa suffers the most, probably on account of its large leaves and somewhat succulent bark. Osage orange endures hail better than any other of the broad-leaved trees.

PLANT BREEDING

THAT the breeding of plants has become a reality may be inferred from the titles of a few recent papers, the contents of which are too technical to be outlined or abstracted here. Thus we have W. J. Spillman's "Application of Some of the Principles of Heredity to Plant Breeding" (Bull. 165, Bureau of Plant Industry, U. S. Dept. Agric.), covering 74 pages, with text, tables, diagrams and a full index. And next—E. M. East's "Distinction between Development and Heredity in Inbreeding" (*Am. Nat.,* 1909), followed by four papers by G. H. Shull, viz., "A Simple Chemical Device to Illustrate Mendelian Inheritance" (*Plant World,* 1909); "The Results of Crossing *Bursa bursa-pastoris* with *Bursa heegeri*" (Proc. 7, International Zool. Congress); "Inheritance of Sex in Lychnis" (*Bot. Gaz.,* 1910); "Color Inheritance in *Lychnis dioica* L." (*Am. Nat.,* 1910).

GENERAL NOTES

A YEAR or so ago Professor E. B. Copeland published as Bull. 24 of the Philippine Bureau of Education a suggestive pamphlet including first, an "Outline of a Year's Course in Botany in the Philippine Secondary Schools," and second, a "Key to the Families of Vascular Plants in the Philippine Islands." While especially helpful to the teachers on the islands, it will prove useful to many teachers in the United States.

Maiden and Betche's "Notes from the Botanic Gardens of Sydney, New South Wales," includes a number of descriptions of new species, and new localities of hitherto known species. Two good plates accompany the paper.

New parts of Karsten and Schenck's "Vegetationsbilder" (Gustav Fischer, Jena) include very different types of vegetation. Dr. Rikli, of Zurich, describes and beautifully illustrates the vegetation of Danish West Greenland, and F. Seiner, of Graz, does the

same for the dry steppes of the northern and middle Kalahari region in South Africa. The contrast between the two regions covered by these two Hefte is most striking. The illustrations continue to maintain the high standard of excellence which they have shown from the beginning of the series.

Professor Hansen's bulletin on "The Wild Alfalfas and Clovers of Siberia, with a Perspective View of the Alfalfas of the World" (Bull. 150, Bureau of Plant Industry, U. S. Department of Agriculture) tells, first, of his several journeys into parts of Siberia, and then discusses quite particularly three Siberian alfalfas, viz., *Medicago falcata, M. platycarpa* and *M. ruthenica,* all of which are cultivated. Common alfalfa, *M. sativa,* and sand lucerne, *M. media,* are grown also, as are *M. glutinosa* and *M. arborea* (often 10 feet high) to a very limited extent.

Professor Gates attempts to make an analytical key to some of the segregates of *Oenothera* (Twentieth Annual Report of Mo. Bot. Garden), and succeeds in designating no less than twenty-two "species," beginning with *Oenothera biennis* of Linnaeus. The author finds it necessary to add one new species, *O. rubricalyx* which "originated as a mutant from *O. rubrinervis* two years ago." Surely we are making progress in regard to a practical acceptance of evolution!

"Some Unsolved Problems of the Prairies" are discussed, by Professor H. A. Gleason, in the *Torrey Bulletin* for June, 1909. He confines himself to the Illinois prairies where they "were converted into cornfields long before the development of ecology and phytogeography in America, thus forever prohibiting the satisfactory investigation of some questions of the most absorbing interest." The sources of information still available are enumerated, and then he discusses eight problems which have hitherto remained unsolved.

Allied to the last is Professor C. H. Shaw's paper on "Present Problems in Plant Ecology" in the *American Naturalist* for July, 1909, dealing very largely with those problems that develop in the study of alpine vegetation, including heat, precipitation, length of season, light and evaporation. Little more is attempted than the setting forth of the problems in a distinct form. At the close the author expresses the wish which every botanist will echo, "that some one whose knowledge of physics and physiology fits him for such a task should overhaul and scrutinize our ideas and methods," and a little later says "there can be no question that ecology at the present time contains not a little of discernible error." And to the latter there is a chorus of "amens" from scientific botanists everywhere.

The same author shows (in *Plant World,* August, 1909) that "timber-line" on high mountains is often due to the action of the snow.

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SPECIAL ARTICLES

ARTIFICIAL PRODUCTION OF MULTIVOLTINE RACES OF SILKWORMS

The domesticated moths known as silkworms have been the subject of much interesting observation and experiment in recent years. The work of Toyama,[1] Coutagne[2] and particularly that of Kellogg[3] in this country, has added much to our knowledge of the hereditary processes revealed by the manifold varieties of this insect. In a recent study Miss McCracken,[4] continuing the previous work in Professor Kellogg's laboratory, has studied the heredity of the race characters, bivoltism and univoltism, in the silkworm. By the former term is meant the condition by virtue of which two broods are produced annually, whereas in the univoltine form, but one brood is reared, the eggs laid in the spring wintering over and hatching out the following spring. This racial character being a physiological rather than a morphological one, is of peculiar interest in heredity.

The elaborate breeding experiments of Miss

[1] *Bull. Agricultural Coll.,* Tokyo Imp. Univ., VII., 1906.

[2] *Bull. Scient. de la France,* XXXVII., 1903.

[3] "Inheritance in Silkworms," *L. S. Jr. Univ. Pub.,* 1908.

[4] *Jour. Exp. Zool.,* 1909, VII., 747.

McCracken extending over a period of five years seem to indicate that the character does not follow out the Mendelian ratio in hybridizing, but rather that the bivoltine character shows an increasing prepotence over the univoltine character in consecutive generations. Miss McCracken interprets this as a reversion to an ancestral condition.

One of the most significant results obtained by Tower in his work with *Leptinotarsa*,[5] consisted in so altering the nature of the germ plasm of his developing beetles by certain "stimuli" that a normally two-brooded form became five-brooded—a condition that was perpetuated in succeeding generations.

Somewhat along the same line, certain experiments carried out in Japan and recorded in an obscure journal[6] would seem to deserve recognition, if only because of their interest in connection with the above-mentioned work of Tower and Miss McCracken. As it is unlikely that this paper is either accessible or intelligible to the majority of occidental biologists, it may be worth while to give a brief abstract of it, in the hope that some one may be induced to repeat the rather uncritical experiments of the Japanese and thereby throw more light on the interesting phenomena of alteration of brood habit.

The article is entitled "The Artificial Production of Trivoltine Silkworms from Bivoltine," and the writer, Mr. K. Tsukai, begins by relating how an experienced silkworm grower named Matsumoto, living in a town of Shizuoka-ken, called Uragawa, brought some bivoltine silkworm eggs of a dealer some twenty miles to the north, intending to keep them over the winter and rear them the following spring. To his astonishment, after a few weeks, the eggs began to hatch. He thought at first that he had been tricked in his purchase, but on recollecting that the climate of his own town and that from which his eggs had come is quite different, he resolved to suspend judgment pending investigation. He found, indeed, that there was a difference of five or six days in the hatching interval in the two places, the worms which issue in twelve to thirteen days ordinarily, requiring there some eighteen days. Conceiving that a sudden temperature change might have occasioned this alteration in the physiological habit of his silkworms, he decided to experiment.

Near Takizawa is a famous cavern, the temperature of which varies little from 60° [Fahrenheit?] the year round. Within this cave he placed some eggs of the first brood of a bivoltine race, intending to delay their hatching until the eighteenth day. Eggs placed in the cave three days after laying and kept there nine days, on being removed, hatched out three days later, apparently unaltered by their stay in the cave. Next year (1903) he took up the matter again. Some bivoltine eggs were divided into two lots. The first were "brushed down" (first instar), March 31, pupated May 17 and emerged June 7. The eggs of these moths after a two-day interval were placed in the cave (March 24). After 13 days, *i. e.*, June 6, they were taken out. Six days later (June 12) they hatched. In rearing them, it was found that the cocoons were inferior to those of the second brood. The average cocoons of the second brood run about 270 to the *sho* (1.8 liters). These ran about 308. Of these only four or five revealed the trivoltine character.

The first brood of the second lot were "brushed down" April 15, pupated May 17 and emerged June 7. The eggs from these after a two-day interval were placed in the cave. After a stay of nineteen days (June 27) they began to hatch in the cave. The worms were "brushed down" and reared, but were very thin and "thread-like." Larvæ in the second moult average about 15.4 g. in weight. These did not exceed 10.5 g. They pupated July 23. The cocoons were very light and small, 358 of them bulking the same as 255 of the ordinary second brood.

Nevertheless, these all hatched out as trivoltine moths. Thus the experimenter's aim had been accomplished.

It is to be regretted that the Japanese writer does not give more explicit information as to

[5] Carnegie Pub., No. 48, 1906, p. 289.

[6] *Dai Nihon San Shu Kwai Ho* (Rept. of the Sericultural Assoc. of Japan), No. 171, p. 5, 1906.

the details of the third metamorphosis. Some of the specimens were given to the local sericultural school for experimental breeding, and by it distributed so that a number of silk growers in the vicinity are now rearing the trivoltine form.

The cave is described as lying in the south side of a mountain leading downward about 350 yards. The interior is moist and dripping. The temperature as mentioned before is 60°.

The larvæ were placed in a corner of the cave on the top of a "coal oil box" and enclosed in a double packing box (such as is used for storing treasures in go-downs). This box measured externally two feet square by one and a half feet high. The inner wall, one foot two inches square by about one foot high. The space between was filled with sawdust. (Apparently no record was made of the temperature of the interior of the box.)

In concluding, Mr. Tsukai remarks that some successful results have been recently reported in changing a trivoltine race into a quadrivoltine, presumably by the same method. He attributes the change to an inhibition of development through a lowering of the temperature. If so, it should be easy to reproduce the results described.

If it is true that the bivoltine races can be converted into trivoltine so easily, it would seem unlikely that the condition of bivoltism can be explained as a case of reversion.

J. F. Abbott

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION B—PHYSICS

The annual meeting of the American Association for the Advancement of Science, Section B, was held in Boston, beginning Tuesday morning, December 28, and closing Friday noon, December 31, with two sessions daily. All sessions except that on the closing day were joint sessions with the American Physical Society. That on Tuesday afternoon was participated in also by Section A, and that on Friday was a joint session with Section L. The presiding officers were Vice-president Bauer, of Section B, and President Crew, of the American Physical Society. All the meetings were held in the physics lecture room of Walker Building, Massachusetts Institute of Technology, except on Wednesday, when both sessions were held in Cambridge at the Jefferson Laboratory of Harvard University. The attendance was uniformly good, varying from one hundred to two hundred. Fifty-nine papers and addresses were presented at the meeting.

On Wednesday evening there was an informal dinner for physicists at the Hotel Vendome and on Thursday afternoon a reception was given to all visiting physicists and their ladies by President and Mrs. Maclaurin of the Massachusetts Institute of Technology, at their home. Both of these were well attended and greatly enjoyed. An informal dinner and conference of the officers of Section B and of the American Physical Society on Tuesday evening led to a satisfactory plan for a more complete cooperation of the two organizations and a better agreement with respect to the range of activity of each.

A short business session on Tuesday resulted in the selection of the following officers for the meeting next Christmas at Minneapolis:

Vice-president and Chairman of Section—E. B. Rosa, Washington, D. C.

Secretary—A. D. Cole, Columbus, O.

Member of Council—W. S. Franklin.

Sectional Committee—L. A. Bauer, E. B. Rosa, A. D. Cole, A. Trowbridge, A. P. Carman, G. F. Hull and E. L. Nichols.

Member of General Committee—F. P. Whitman.

Several new members were added to the section and fifty members were made fellows of the association.

At the joint sessions on Tuesday afternoon and Friday morning an effort was made to provide programs that would be of interest to others than physicists. The papers presented were wholly by invitation. The large audiences—approximately two hundred in each case—and the interest shown demonstrated the success of this effort and led to a decision to adopt the "general-interest session" as a permanent policy. The program on Tuesday was presented by Sections A and B jointly and that on Friday by Section B. These programs follow.

TUESDAY AFTERNOON, DECEMBER 28

Some Reforms needed in the Teaching of Physics (vice-presidential address of Section B): Professor Karl E. Guthe, of the University of Michigan.

On the Determination of Latitude and Longitude in a Balloon: Professor C. RUNGE, of the University of Berlin.

The Ruling of Diffraction Gratings: Professor A. A. MICHELSON, of the University of Chicago.

On Certain Physical Hypotheses sufficient to explain an Anomaly in the Moon's Motion: Professor E. W. BROWN, of Yale University.

Professor Guthe's address has been printed in full in SCIENCE, January 7, 1910, and an abstract of that of Professor Runge is printed in SCIENCE for January 28 (Report of Section A). Abstracts of the other two are given below:

On the Ruling of Diffraction Gratings: A. A. MICHELSON, University of Chicago.

The difficulty with the echelon and other interferential methods of great resolving power lies in the large number of overlapping spectra. In the grating great regularity in spacing is required if high resolving power is sought. The use of the cadmium red line makes it possible to secure the needed regularity in spacing, since the alternations of dark and light interference bands can be observed through 250,000 wave-lengths.

After long labor it has been found possible to make gratings as efficient in resolving power as are the echelon and other interferential apparatus. An idea of the accuracy required is gained from the consideration that errors must not exceed .00001 inch when not systematic; if they are systematic much greater accuracy than this is necessary to avoid "ghosts," say to .000001 inch. The best screws when they come from the lathe have errors of about .001 inch. By grinding, say a month, with a special nut, these can be reduced to about .0001, and by further labor to .00002 inch. Beyond this, local processes of correction become necessary.

To secure gratings of sufficient length for the great resolving power desired, it was necessary to use a screw three times as large as that used in Rowland's machines. His method of grinding was tried for a long time without securing satisfactory results. By the use of a grinding nut cut into three parts and with very fine emery success was finally reached. The use of too coarse emery in order to save time caused the wearing out of one screw before its errors were removed. Attempts to grind under oil and under water were made, but given up. Finally the following method was used: grinding for several months with the nut kept wet with soap and water; errors were then determined with the interferometer; then a correcting nut with an arrangement for rubbing harder on one side of the thread than the other was applied. In this way the errors were brought down to about .000002 inch. (The method for the final correction was also described.)

To work in the second-order spectrum 250,000 lines, or a grating fifteen inches long, was needed. To secure necessary rigidity in a screw long enough to rule this length, it must weigh thirty or forty pounds. Nine tenths of this weight was sustained by floating on mercury. Steel can not be used for the nut; a yielding material is required. Wood was used, as by Rowland. As great accuracy of ways is necessary, one bearing surface only was used instead of four as in a lathe. Great trouble was found in securing suitable diamonds for ruling. No difficulty was found the first year, after that not a good one was found for six years. Finally through Sir Wm. Crookes a satisfactory diamond was obtained from a certain mine which yields extra hard stones. To prevent undue wear very light pressure only on the tracing point was used, and the ruling subsequently deepened by etching. Only flat gratings have been ruled, as these can be made of higher accuracy than concave gratings.

On Certain Physical Hypotheses sufficient to explain an Anomaly in the Moon's Motion: ERNEST W. BROWN, Yale University.

Newcomb has shown that there is a difference between the observed and theoretical positions of the moon which can be roughly represented by a term of period about 270 years and coefficient 13″.

In the paper the author has examined numerous hypotheses sufficient to explain the term, in order to clear the ground of those which seemed to be of doubtful value and to bring forward those which appeared sufficiently reasonable to merit tests from observations of a different nature. Some account of three of these hypotheses was presented to the meeting. It was stated that a minute libration of the moon would be sufficient, provided it took place in the moon's equator and had the proper period. The supposition of magnetic attraction practically demanded (*a*) a periodic change in the magnetic movement of the earth or of the moon. If (*a*) were rejected, it was necessary to suppose that the mean place of the lunar magnetic axis was near the lunar equator and that the oscillations of its position took place in the plane of the equator. The observed secular change of the earth's magnetic axis could not

produce the phenomenon without demanding a larger motion of the lunar perigee than observation warrants. On the border line between two sets of hypotheses was a curious fact, namely, that if the period of the solar rotation coincided very nearly with one of the principal lunar periods a minute equatorial ellipticity of the sun's mass was sufficient to explain the term. So far as known, these hypotheses do not conflict with any observed phenomena, but they cause some theoretical difficulties.

PROGRAM OF THE JOINT SESSION OF SECTION B AND SECTION L, FRIDAY MORNING, DECEMBER 21

The Relation of Colleges to Secondary Schools with respect to Physics: Professor E. H. Hall, of Harvard University.

What Specialization has done for Physics Teaching: Professor John F. Woodhull, Teachers College, Columbia University.

The Quantitative Teaching of Kinetics in Secondary Schools: N. H. Black, of Roxbury Latin School, Boston.

The Place of "g" in High School Teaching and other Topics: Professor A. G. Webster, of Clark University.

College Attitude toward Preparatory Work: Professor C. R. Mann, University of Chicago.

These papers were followed by an animated general discussion in which the following educators participated: Professors Guthe, of the University of Michigan; Hall, of Harvard; Franklin, of Lehigh; President McNair, of Michigan School of Mines; Professors Webster, of Clark; Woodhull, of Columbia; Mann, of Chicago; Hull, of Dartmouth; Rosa, of the Bureau of Standards, and Slate, of the University of California.

At the joint sessions of the American Physical Society and Section B, the following forty-nine papers were presented. Abstracts of many of these papers may be found in the February number of the *Physical Review* and others may be expected in later numbers of the same periodical.

Temperature Coefficient of Electrical Resistance—Tungsten, Molybdenum, Nickel and Nichrome: A. A. Somerville.

The Flow of a Gas through a Capillary Tube: Willard J. Fisher.

Effect of Surface Tension upon a Falling Jet of Water: F. R. Watson.

The Variation of the Hall Effect in Metals with Change of Temperature: Alpheus W. Smith.

The Effect of Pressure on the Electrolytic Rectifier: A. P. Carman and G. J. Balzer.

The Analysis of the Principal Mercury Lines by Diffraction Gratings and a Comparison with the Results obtained by other Methods: Henry G. Gale and Harvey B. Lemon.

The Spectra of some Gases in the Region of Extremely Short Wave-length: Theodore Lyman.

The Variation of the Hall Effect with the Temperature in the Case of the Principal Magnetic Metals: Thomas C. McKay.

The Rectifying Effect in Point and Plane Discharge: Robert F. Earhart and Chas. H. Lake.

Photographic Photometry, and some Interesting Photographic Phenomena: Charles F. Brush.

Note on "Changes in Density of the Ether, and some Optical Effects of Changes in Ether Density": Charles F. Brush.

The Tone Quality of the Flute: D. C. Miller.

An Instrument for Projecting and Recording Sound Waves: D. C. Miller.

The Magnetic Measurements on Board the "Carnegie" in 1909: L. A. Bauer.

The Relativity Dilemma: D. F. Comstock.

"Bound Mass" and the Fitzgerald-Lorentz Contraction: Will C. Baker.

Physical Properties of Binary Liquid Mixtures: J. C. Hubbard.

On the Use of Polar Coordinates in Thermodynamics: J. C. Hubbard.

The Theory of the Vibration Galvanometer: F. Wenner.

Coefficients of Linear Expansion at Low Temperatures: H. G. Dorsey.

The Freezing of Mercury at High Pressures: P. W. Bridgeman.

Phenomena of Spark Discharge through Wire Conductors: Francis E. Nipher.

Some Minute Phenomena of Electrolysis: H. W. Morse.

A New Method of Measurement of Small Angles: C. W. Chamberlain.

The Photographic Evidence for Dispersion of Light in Space—Is it a purely Photographic Phenomenon? H. E. Ives.

On the Secondary β Radiation from Solids, Solutions and Liquids: S. J. Allen.

The Effect of Filter Paper upon the Mass and Form of the Deposit, in the Silver Coulometer: E. B. Rosa, G. V. Vinal and A. S. McDaniel.

Experiments in Impact Excitation with the Lepel Singing Arc: George Nasmyth.

On the Coefficients of Diffusion of the Emanation and the Active Deposit Particles of Actinium: J. C. McLennan.

On the Relative Numbers of Positive and Negative Ions present in Atmospheric Air: A. THOMSON.

Note on the Cause of the Discrepancy between the Observed and Calculated Temperatures after Expansion in the Space between the Plates of a Wilson Expansion Apparatus: R. A. MILLIKAN, E. K. CHAPMAN and H. W. MOODY.

Some New Values of the Positive Potentials assumed by Metals under the Influence of Ultra-violet Light: R. A. MILLIKAN.

The Second Order Effect of Ether Drift on the Intensity of Radiation: A. TROWBRIDGE and C. E. MENDENHALL.

The Rotary Dispersion of Quartz at —190° C. and Observations at other Temperatures: F. A. MOLBY.

The Pyrheliometric Scale and the Solar Constant: C. G. ABBOT.

Single-line Series in the Spectra of Ca and Sr: F. A. SAUNDERS.

The Relative Motion of the Earth and the Ether: H. A. WILSON.

A Study of the Multiple Reflection of Short Electric Waves between two Reflecting Surfaces: L. E. WOODMAN and H. W. WEBB.

A Hot Air Engine Indicator Diagram: A. G. WEBSTER.

The Nitrogen Thermometer from Zinc to Palladium: A. L. DAY and R. R. SOSMAN.

On Calcium Clouds in Space: Dr. STIFER (presented by Percival Lowell).

The Second Postulate of Relativity: R. C. TOLMAN.

The Terminal Velocity of Fall of Small Spheres in Air: JOHN ZELENY and L. W. MCKEEHAN. (By title.)

The Present State of our Knowledge concerning Permanent Magnetism: A. A. KNOWLTON. (By title.)

The Heat of Dilution of Aqueous Salt Solution: F. L. BISHOP. (By title.)

Uranous and Uranyl Bands—A Very Fine Band Absorption Solution Spectrum: W. W. STRONG. (By title.)

Insulation of Observatory Domes for Protecting Telescopes and other Apparatus against Extremes of Heat and Cold: DAVID TODD. (By title.)

On the Free Vibrations of a Lecher System: F. C. BLAKE and CHAS. SHEARD. (By title.)

Thunderstorm Electricity: W. W. STRONG. (By title.)

ALFRED D. COLE,
Secretary

OHIO STATE UNIVERSITY

SECTION L—EDUCATION

THE Boston meeting of Section L was unusually successful. The attendance varied from 50 to 110. The policy of the section of devoting each session to a single topic was again carried out. The section committee has voted to continue this policy for future meetings. President A. Ross Hill, of the University of Missouri, was elected the vice-president of the section and Professor John Dewey, of Columbia University, was elected member of the sectional committee.

Probably the most important contribution to the meeting was the address of the retiring vice-president, Professor Dewey, on "Science as Method and as Information." With great clearness it was pointed out what results follow from considering science merely as information and from teaching it accordingly. Only when science is studied as a universal method of obtaining knowledge will science take the important place that is now awaiting it in educational work. The paper has been printed in full in SCIENCE for January 28.

The first session of the section was devoted to a discussion of the topic, "Formulated Scientific Problems in General Education." The first speaker was Professor Edward L. Thorndike, of Columbia University.

He showed that a scientific treatment of education demands means of measuring the facts, changes and relations with which education is concerned. Some useful units of measure and scales for measuring are furnished by physiology, psychology and allied sciences. But in such cases as amount of knowledge of a language, degree of ability in English composition, quality of handwriting, improvement in manners or morals and the like students of education should devise units of measure and arrange scales for teachers. Any product or response or quality which varies in amount can be measured even though it is complex, subtle and subject to an enormous effect from the personal equations of observers.

The desiderata in a scale for the measurement of educational facts are: (1) that the points on the scale be defined with exactitude, (2) that a difference of one should have the same value no matter where on the scale it occurs, (3) that the values attached to points on the scale should all refer to a defined and useful zero, preferably one signifying no amount whatever of the fact in question, and (4) that the scale be convenient

and fine enough. The speaker showed portions of a scale for the quality or goodness of handwriting in the case of children ten to sixteen which approximately realized these desiderata. The method of securing such a scale was explained.

Professor Charles H. Judd, director of the School of Education of the University of Chicago, presented some suggestions of experiments in education. Professor Judd pointed out that many tests have been proposed by committees and individuals in the hope of providing a means of collecting from large numbers of persons data which can be made the basis of elaborate studies of individual differences. These tests have been of little general use and the comparisons which they permit are of doubtful value. One of the chief reasons for this failure of tests is, I believe, to be found in the fact that they deal with the products of mental development rather than with the processes by which mental development is attained. Thus to take a concrete case, many tests have been made of the ability of individuals to reproduce a line exposed to inspection for a short interval. The ability to reproduce such a line is the product of a long series of experiences in which an indefinite variety of favorable and unfavorable conditions are involved. A single test can no more throw light on the mental complex which is involved in the reproduction of a line, than a single inspection of the external aspect of an animal can throw light on the process of organic evolution. What is needed is a test which shall bring out a succession of efforts to produce the line.

A second general type of test which I believe could very advantageously be tried on a large scale would be directed toward the solution of the problem of the different interests of children at their different ages. Let different types of material be presented to the whole school on such a general occasion as the general assembly, and let each child get as much out of the material presented as he can. Then let all the school be called on to write on what was seen or heard. To make this recommendation concrete, let one such demonstration be devoted to the explanation and exhibition of a simple scientific test of specific gravity, or the center of gravity. Let a second consist in a purely imaginative description calling upon the child for the exercise of visual imagery.

Finally, I have a general suggestion which, I believe, might properly be laid before this section. Many teachers are trying elaborate experiments in one subject or another and need help on the methods of testing their experiments. Thus a teacher is using the natural method, another the grammatical method, of teaching modern languages. Some teachers are trying the method of teaching geometry through concrete demonstrations rather than the conventional Euclidean logical demonstrations. The student of education needs only to go to the meetings of modern language teachers and teachers of mathematics to hear discussions of many such experiments. What is needed is the collection of all these experiments so that we may be intelligent as to the tendencies of actual practical school experimentation. Section L could, in my opinion, render no greater service than to organize a movement for the generalizing of such educational experimentation.

Professor George H. Mead, of the University of Chicago, presented a paper on "The Psychology of Social Consciousness" implied in instruction. The paper will be printed in full in SCIENCE. Its argument is as follows:

Primitive education is actually studied by that form of psychology which is termed social, because primitive education gathers about play, imitation and the reaction of adolescent emotion into initiatory ceremonies. On the other hand, the psychology which has scientifically studied the education in our modern school-systems has been largely intellectualistic, it has studied the subject matter that the child is to learn only from the point of view of the material in the mind of the child, of the associations by which it can be taught, and by the repetition of which it can be held in the child's mind. Thus the material of instruction and its acquirement is entirely separated from the social situation and its consciousness, which is implied in the relation of the child to his teacher, to the other children in the school, to the family that sends him to school, and to the society as a whole which is educating him to become a citizen. To the fact that the modern school has ignored to such a large degree the social nature of the child in the process of his schooling can be traced most of the admitted defects in methods of teaching. Actually both the form of instruction is social, *i. e.*, language which is the vehicle of converse between social selves; and the subject matter, *i. e.*, the material toward which our socially organized impulses, and the attention which is dependent upon them, are directed. Neither this form nor the subject matter of instruction can be scientifically con-

trolled unless we frankly recognize their social nature, and that of the children who are to be instructed. In this sense, if in no other, the scientific study of education implies a social psychology as a technique.

Professor W. F. Dearborn, of the University of Chicago, discussed "Problems in the Psychology of Reading."

A fundamental problem in education is that of finding ways to estimate accurately the rate of progress of pupils in their school studies—accurate tests are of value not only for measuring individual progress, but as a means for determining the relative merits of different methods of instruction. The test to which I wish to call your attention furnishes a means for estimating individual progress in learning to read—and thus affords a basis for judging of the success of the methods of instruction employed in teaching reading.

I assume your acquaintance with the general fact that there is among the physiological basis of reading, a peculiar form of movement of the eyes, of which the principal features are several distinct stops or pauses in each line that is read, with very rapid movement between pauses. This habit must be acquired just as any other, as, for example, the coordination of movements in learning to write, although we have not established the aids to its acquisition which exist in the case of handwriting. In fact, from the standpoint of the movements concerned we are not at all certain as to what constitutes good form in reading.

Some investigations of the qualities of merit in teachers were presented by William C. Ruediger, assistant professor of educational psychology in the George Washington University, Washington.

The following fourteen items of information were secured from twenty-six elementary schools: (1) the teachers by grades, numbered consecutively; (2) the highest certificate, diploma or degree held; (3) experience in years; (4) general merit; (5) health; (6) personal appearance; (7) initiative or originality; (8) strength of personality; (9) teaching skill; (10) control or ability to keep order; (11) ability to carry out suggestions; (12) accord between teacher and pupil; (13) progressive scholarship, and (14) social factor outside of school.

Beginning with the fourth item, the teachers were arranged by numbers in their order of merit, and the various items were correlated with general merit, by the Woodworth method of per cent. of displacement. The average per cents. of displacement obtained were for (3) 32; (5) 48; (6) 40; (7) 25; (8) 27; (9) 23; (10) 22; (11) 31; (12) 31; (13) 28; (14) 36. (7) compared with (11) gave an average displacement of thirty-one per cent. (8) compared with (12) gave an average displacement of 32 per cent. The best teachers had taught an average of fourteen years and the poorest eight years. No teacher ranked first or second had taught less than five years. 69 per cent. of the best teachers were found in the four extreme grades, while 57 per cent. of the poorest were in the four intermediate grades. Of the normal school graduates 28 per cent., of certificated teachers 21 per cent. and of college graduates 17 per cent. occupied first and second rank. The corresponding percentages for the two lowest ranks were for the normal graduates 16 per cent., certificated teachers 21 per cent., high school graduates 36 per cent. and college graduates 44 per cent.

The second session was devoted to a discussion of "Scientific Studies of the American College." The first speaker, Mr. E. C. Sage, assistant secretary of the general education board, discussed the "Geographical Location and Sphere of Influence of Colleges in the United States," as follows:

From the planting of Harvard College in Cambridge, Mass., in the year 1636, to the founding of the new college in Portland, Ore., in the autumn of 1909, the increase of colleges has kept pace with the westward movement of the population. The selection of sites for the location of colleges seems to have been made with slight regard to the existence of other institutions; for example, in and about Los Angeles, Cal., there are six colleges; in the Willamette Valley, Ore., a territory fifty by one hundred and thirty miles, there are seven colleges; in Kansas there are twenty-five colleges; in Iowa there are twenty-nine colleges; in Ohio there are no fewer than fifty-two institutions empowered by law to grant the bachelor's degree. A part of the Missouri Valley extending a distance of two hundred and fifty miles across the state of Missouri seeks to support nineteen colleges. Pennsylvania, with twenty-nine colleges, maintains eleven in her western range of counties, while Nebraska in her southeastern section, in a territory with a radius of fifty miles, has nine. In at least seven states it is possible to find as many as ten colleges in a territory circumscribed by a circle with a radius of fifty miles.

"National" Colleges.—The number of colleges, including the departments of arts and sciences of universities, which receive at least two students from at least twenty-five states, is fifteen. Of these, five are colleges for women only, five for men only, and five are coeducational. While these are designated as "national," a large proportion of their students come from a local territory, the proportion from within fifty miles ranging from twenty-three per cent. to fifty-five per cent.

Southern Colleges.—There are five southern colleges which enroll at least two students from each of ten southern states.

State Universities.—Naturally enough, most state universities serve principally the respective states in which they are located. There are three conspicuous exceptions; namely, the University of Michigan, with forty-one per cent. of its students coming from beyond state lines; the University of Virginia, receiving forty per cent. of its students from outside states, and the University of Wisconsin, enrolling nineteen per cent. of its students from beyond state boundaries.

The state universities, as a rule, serve widely their respective states; for example, the University of Indiana draws two or more students from ninety of the ninety-two counties of the state; the University of Illinois, from seventy-three of the one hundred and two counties of the state; the University of North Carolina, from sixty-seven of the ninety-seven counties of the state.

Colleges and States.—A survey of institutions, state by state, discloses the fact that only a few colleges in each commonwealth secure students in any considerable numbers from all parts of the state; for example, in the following eleven states the number of colleges which have two or more students from one half of the counties of their respective states are: Virginia, none; North Carolina, three; Georgia, none; South Carolina, three; Florida, none; Tennessee, none; Pennsylvania, one; Ohio, two; Indiana, two; Illinois, three; California, two. Of these fifteen colleges, six are state institutions.

The New England Colleges.—The colleges of New England differ from those found where the states are large. Nearly all receive students from all counties of the states in which they are respectively located, but when the field surveyed is narrowed to a radius of fifty miles many of the colleges are as local as any found in the United States; for example, fifty per cent. of the students of Bowdoin College are from within fifty miles; Harvard College, fifty-two per cent.; Bates College, fifty-six per cent.; Brown University, sixty-two per cent.; University of Vermont, sixty-five per cent.; Boston University, eighty-one per cent. Yale receives thirty-two per cent. of her students from New England and twenty-seven per cent. from New York State, making fifty-nine per cent. from New England and New York State. Dartmouth receives sixty-seven per cent. from New England. Other New England colleges are even more local.

General Conclusions.—From studies similar to those indicated above, general conclusions are drawn as follows:

1. A few colleges, numbering less than twenty, may be properly designated as "national," but even those so-called "national" colleges receive but a small proportion of their students from distant parts of the country.

2. A few southern colleges, numbering not more than five, serve in a large way the southern states, but these, likewise, are largely local.

3. The state universities, with two or three exceptions, are local within the state; but while drawing few students from without, they secure students from large portions of the state in which they are respectively located.

4. A very few of the private institutions are found which draw two or more students from one half of the counties of the state in which they are located. Several states have no such colleges.

5. All other institutions are emphatically local. When these colleges are located in a city or town of considerable size, one fourth to one third of the students are from the town or city and from fifty to eighty per cent. are from the immediate vicinity.[1]

Professor George D. Strayer, associate professor of education in Columbia University, presented the following data collected by a special inquiry of the bureau of education, from 93 colleges concerning the student body in American colleges.

In comparing the size of freshman, sophomore, junior and senior classes it is found that the median per cent. of the freshman class found in the sophomore class is 71 for men, 65 for women.

The junior class shows 55 per cent. of the freshman class as a median for men and 44 per cent. as a median for women. On the same basis the median for the senior class for men is 46 per cent. and for women 42 per cent. The median age for graduation for men is 23 years and one month.

[1] The estimates are based upon the enrollment of students in the four classes of the department of arts and sciences.

The median ages of graduation for the middle 50 per cent. of the colleges are included within the limits, 22 years and 6 months, 22 years and 9 months. For women the median age is 22 years and 8 months, the middle 50 per cent. falling between the limits 22 years and 23 years and 3 months.

The economic status of college students may be roughly indicated as follows: 19 per cent. have fathers who are engaged in professional work; 15 per cent. have fathers who own farms worth more than $5,000; 7 per cent. have fathers who own smaller farms; 20 per cent. have fathers engaged in trade or commerce, making more than $2,000 a year; 15 per cent. have fathers who make less than $2,000 a year in trade or commerce; 6 per cent. have fathers who are skilled laborers; 3 per cent. have fathers who are unskilled laborers, and the fathers of 15 per cent. of the students are dead.

Further light upon the economic status of students is shown by the fact that 25 per cent. of the student body engage in gainful employment for from four to twenty-four hours or more, per week, while in college.

Mr. Clarence F. Birdseye, editor of the new journal, *The American College*, and director of the Higher Education Board, spoke on the purposes of that association. Mr. Birdseye explained how the life of the student is lived upon three distinct planes; the statutory or the governmental plane, wherein the written law defines, commands or forbids certain rights, duties and acts; the contract or community plane wherein contracts, more or less formal, govern his relations with his fellows; and lastly, the home plane, wherein the parent enforces his commands under quite a different law from that of the other planes. The college used to pay considerable attention to the development of students on the home and the community planes, but now has centered all its efforts on the statutory or governmental plane. The new college and new style of learning required constantly more money for new buildings and a larger faculty. It gradually abandoned its home functions and centered its attention on the curriculum with a corresponding loss of its power to build up strong character. The college also offers no opportunity for recognizing unusual power or successful work by instructors. The Higher Education Association believes that the colleges need standardizing of efficiency and that this must come through radical changes in the college administration.

Extracts were read from the charter of the association to show how this would be done. The paper will be printed in full in SCIENCE.

Professor Wm. G. Hale, professor of Latin at the University of Chicago, presented a paper on "Problems in Grammatical Terminology."

The third session of the section was devoted to the report of the committee on the distribution of students in college courses.

Professor E. L. Thorndike, as chairman of the committee appointed to collect facts concerning (1) the practise of American colleges with respect to the number of students taught in one group by one instructor, and concerning (2) the studies actually taken by individual students to fulfill the requirements for the bachelor degree, presented the following data: (*a*) a list of the colleges which report in print more or less adequately the provision for teaching each course offered, and the number of students enrolled in it; (*b*) a table of frequencies of classes of different sizes in some twenty institutions, a class being defined as a group dependent on one person for their instruction in the subject; (*c*) a statement of the variation amongst institutions in the size of class in certain instructive cases, such as the first course in history, the first course in psychology, the first and second courses in French and German; (*d*) the per cent. of the total degree requirement given by each student to each subject in the case of some five hundred students from sixteen institutions; (*e*) measurements for the frequency of specialization in each institution; (*f*) measurements of the frequency of superficiality or scattering in each institution.

The following resolutions were presented by the committee and adopted:

Resolved, That samples of the facts concerning the number of students taught by one instructor be sent to the colleges and universities on the list of the United States Bureau of Education.

Resolved, That those in charge of collegiate instruction in each of these institutions be requested to report in print or to this committee any facts concerning the relation of the size of class to efficiency in teaching, with special reference to the following questions:

1. Is not the number of students taught at one time by a single individual in many college courses so great as to reduce that individual's knowledge of the attitude, preparation, difficulties, errors and achievements of his students to almost zero?

2. Is not the number of students taught at one

time by a single individual in many college courses so small as to involve an enormous waste of the instructor's time and an improper distribution of the appropriations for teaching?

3. Other things being equal, should not the teaching of more than forty college students at one time by one person be avoided? Should not any department have reasons of weight for any such case?

4. Other things being equal, should not the use of a quarter or more of a professor's teaching hours for a year for the instruction of fewer than ten students in one undergraduate course counting one twentieth or less of the degree's total requirement be avoided? Should not any department have reasons of weight for any such case?

5. Should not the traditional method of having the ratio which the number of class meetings is to the number of "points" credit the same, regardless of whether the class enrollment is 1, 5, 10, 20 or 100, be abandoned in many of the undergraduate courses enrolling less than ten students?

6. When, in a college course given annually, the number of students is less than 6, should not the course be offered only once in two years, except for reasons of weight?

Resolved, That those in charge of collegiate education in the colleges and universities on the list of the United States Bureau of Education be requested to consider the advisability of reporting for 1910, and once in every ten years thereafter a detailed statement of the work done for the bachelor's degree by each member of the graduating class or by each of 100 students chosen at random from it.

Beside these three sessions, several joint sessions were held with other organizations. The first of these with the American Federation of Teachers of the Mathematical and Natural Sciences was devoted to the presentation of reports and to a discussion of the work of the International Commission on the Teaching of Mathematics. This session is reported in full in the federation report.

The second joint session was held with the Social Education Club of Boston. The topic of this session was "Equal Opportunity for All."

The third joint session was held with Section B, Physics, for the discussion of the teaching of elementary physics. The report of this meeting will be found in the report of Section B. From the point of view of Section L the meeting had two significant features. The first was that one of the other sections of the association found it desirable to devote one of its sessions to a discussion of the teaching of science, and the other was the wide divergence of opinion expressed at the meeting. It is a hopeful sign that this discussion has been begun and it is certain that the diversity of opinion will gradually disappear if similar sessions may be held at succeeding meetings.

On Wednesday evening the Social Education Club of Boston held a public meeting. At this meeting Mr. Edward L. Stevens, associate superintendent of schools of New York City, presented a significant paper on "Why do Pupils leave the High School before Graduation?" Mr. Stevens's conclusions, based on a careful investigation of a large number of schools, are as follows:

1. Many students enter high schools who do not intend to remain after the age of sixteen or after they secure employment. Of 450 girls entering one of our high schools, about 130 were in this class.

2. Many students find, or think, during the first or second year of the course, that the work they are doing is in no wise calculated to prepare them to work or to work efficiently. I think it may safely be admitted that a year of Latin will be of little, if any, use to a boy who leaves at the end of the first year to enter a trade.

3. Many students of rather mediocre ability find that a course determined largely by college entrance requirements is either too difficult or does not appeal to their abilities or interests.

4. Many students are forced, unwillingly, to leave and go to work by the accidents or embarrassments met by their parents in business.

5. Many students are tempted to leave by the offer of employment at apparently alluring wages.

6. Some students leave because of the severity of the management or of the rigors felt at the hands of university-trained specialists.

7. Some students die, and a considerable number, particularly girls, break down or fail in health. A few girls marry.

The remedial measures suggested are stated in the conclusions which follow:

1. The training of children begins in the home. It should continue in the home. Girls and young women should have a training such that they shall become intelligent and efficient mothers, not only in order to preserve their own health and usefulness, but in order that they may bring up their children. The high school must in this respect, as in others, do much of the work for-

merly done in the home. The home is transferring constantly some of its functions to the school.

2. Many kinds of schools and many kinds of courses should be offered.

3. The needs of communities should be studied in order that students in high schools should not be diverted from labor—but rather prepared for it, and for that kind which is locally needed and for which they are individually adapted.

4. High school teachers must study children and their interests, tastes and capabilities more than subjects or syllabuses.

5. Secondary or higher education must not be considered as a means of escape from labor.

6. Many must be prepared to work with their hands.

7. When we have done all this we shall no longer be concerned about the number who leave high school before graduating, and I rather suspect that we shall not long deliberate on whether pupils have read four or six books of Cæsar, nor shall we discriminate against them if, being girls, they have elected cooking instead of physics, or being boys, they have elected modern civics instead of ancient history.

If it be true that the conditions of law and life require or induce the attendance of children in high schools until they are fifteen or sixteen or seventeen, and the conditions of graduation impose a four years' course, it is quite evident that the schools are being maintained, so far as numbers are concerned, for those who do *not* graduate, or who only remain in school one, two or perhaps three years; and this being the case, the principle of "the greatest good for the greatest number" requires that we shall give them particular and special attention.

C. R. MANN,
Secretary

FIFTH MEETING OF THE ENTOMOLOGICAL SOCIETY OF AMERICA

THE fifth meeting of the Entomological Society of America was held at the Harvard Medical School, Boston, December 30 and 31, 1909. The president, Dr. Henry Skinner, presided throughout the sessions. The president announced the deaths of Henry H. Edwards, an honorary fellow, Professor Mark Vernon Slingerland, a fellow, B. H. Guilbeau, W. Brodie and H. M. S. Seib, members. Suitable resolutions on the deaths of Mr. Edwards and Professor Slingerland were adopted. The report of the executive committee showed, among other things, that 16 new members had been received during the year and 22 memberships had terminated, not including those who had died. Also that a memorial drawn up by Mr. N. C. Wood regarding the tariff on insects and signed by the president and secretary had been productive of no action by congress.

The question of appointing delegates to the approaching International Congress of Entomology was referred to the executive committee.

The following officers were elected:

President—Dr. John B. Smith.

First Vice-president—Dr. S. A. Forbes.

Second Vice-president—Professor V. L. Kellogg.

Secretary-Treasurer—Professor C. R. Crosby.

Additional Members of the Executive Committee—Professor J. H. Comstock, Dr. W. M. Wheeler, Mr. E. A. Schwarz, Professor J. M. Aldrich, Rev. Professor C. J. S. Bethune, Professor Lawrence Bruner.

Member of the Committee on Nomenclature—Professor T. D. A. Cockerell (to succeed himself).

The report of the committee on nomenclature concerning the nomenclature of gall insects read at the Baltimore meeting, and printed in the *Annals* for 1909, was adopted as printed, with the provision that the society express itself as standing with the majority of the committee in section V.

Mr. Brues suggested that Professor Felt submit a list of names of gall insects that he thought could be accepted as standard.

Moved and carried that the request of Dr. Stiles published in SCIENCE, for the preparation of a list of one hundred important names to be adopted by the Congress of Zoology as standard, be referred to the executive committee.

The following amendment to the constitution was adopted: Article V., Sec. 3.—Election of officers. All officers shall be elected by ballot at the annual meeting for the term of one year and shall be eligible for reelection. Their term of office shall commence with the first of June following their election.

The secretary was instructed to take a mail vote of all members and fellows of the society as to whether the present arrangement of paying separate dues and subscriptions to the *Annals* should be continued, or a single membership fee of two dollars be charged, and members receive without further expense the publications of the society.

Professor Sanderson suggested the adoption of a uniform style of button for both the entomological societies meeting in affiliation with the Amer-

ican Association for the Advancement of Science. Referred to the officers.

The following papers were read during the sessions:

R. Matheson: "Remarks on the External Anatomy of the Haliplidæ."

W. M. Wheeler: "On the Effects of Parasitic and Other Kinds of Castration in Insects."

Miss A. H. Morgan: "Some Correlations of May-fly Structure and Habit."

C. R. Crosby: "Some Observations by the Late Professor Slingerland and the Speaker on the Life History of *Heterocordylus malinus*" (read by title).

C. J. Triggerson: "The Life-cycle of the Oak Hedge-hog Gall-fly (*Acraspis erinacea*)."

F. L. Washburn: "A Jumping Seed-gall on the Burr Oak."

A. D. MacGillivray: "The Female Reproductive Organs of *Corydalis cornuta*."

W. L. W. Field: "The Offspring of a Captured Female of *Basilarchia proserpina*." To be published in April number of *Psyche*.

H. H. Lyman: "An Improved Drawer for Insect Cabinets and a New Substance for Lining them."

C. T. Brues: "Some Notes on the Geological History of the Parasitic Hymenoptera."

J. C. Bradley: "The Plaiting of the Wings of Hymenoptera."

T. J. Headlee: "An Apparatus for the Determination of Optimums of Temperature and Moisture for Insects."

A. D. MacGillivray: "The Radial Sector in *Phlebatrophia mathesoni*."

W. T. M. Forbes: "A Structural Study of some Caterpillars."

M. J. Elrod: "The Blackfoot Glacier as an Entomological Burying Place" (read by title).

J. J. Davis: "*Chaitophorus populifoliæ* Fitch versus *Chaitophorus populifoliæ* Oestland" (read by title).

L. Haseman: "The Life History of a Species of Psychodidæ" (read by title).

A. G. Hammar: "Notes on the Life History of *Fidiobia flavipes* Ashmead, an Egg Parasite of the Grape Root Worm (*Fidia viticida* Walsh)."

A very interesting and extensive exhibition was held in conjunction with and under the auspices of the Cambridge Entomological Club in rooms adjoining the meeting hall.

The annual public address was given by Dr. John B. Smith on the evening of December 30 in the hall of the Boston Society of Natural History, title, "Insects and Entomologists: Their Relations to the Community at Large."

On Tuesday evening the visiting entomologists were the guests of the Cambridge Entomological Club at a most enjoyable smoker held in Copley Hall.

J. Chester Bradley,
Secretary-Treasurer

THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

The second annual meeting of the Association of Official Seed Analysts was held in Boston, December 28–29, 1909, in connection with the meeting of the American Association for the Advancement of Science.

Agricultural colleges, experiment stations and state departments of agriculture in twelve states and the Canadian and the United States departments of agriculture were represented.

Three papers were presented as follows:

"The Effect of Alternating Temperature, on the Germination of Seeds," by W. L. Goss, U. S. Department of Agriculture.

"Importance of Uniform Methods of Seed Testing," by A. D. Selby, Ohio Agricultural Experiment Station.

"The Sale of Adulterated Farm Seeds in the United States," by E. Brown, U. S. Department of Agriculture.

The greater part of the time of the meeting was devoted to consideration of the reports of the committees on methods of seed testing and on legislation. The report on methods of seed testing for purity was adopted as official by the association and that on germination as provisional. The report on state legislation was adopted and the secretary was instructed to prepare both reports for publication.

E. Brown,
Secretary

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 228th meeting of the society was held at the George Washington University on Wednesday evening, February 23, 1910.

Mr. E. W. Shaw, in an informal communication, described a log-shaped mass of sandstone included in coal at Murphysboro, Illinois.

Mr. P. S. Smith spoke on the formation of plain surfaces above base-level, with particular reference to such features observed in Alaska.

Mr. D. B. Sterrett presented a description of peculiar boulder or toadstool-like erosion forms occurring over the outcrop of a batholith of coarse porphyritic granite in York County, S. C. Some of these "toadstools" are ten to fifteen feet high and of similar thickness, and are still firmly attached to the underlying granite mass by stems which may be only one third as thick as the boulder. The granite also outcrops as floors or bosses similar to the occurrences at some of the quarries of the Piedmont region.

Regular Program

Some Mineral Relations from the Laboratory View-point: ARTHUR L. DAY.

The fundamental problems of rock formation, to which petrologists are now giving serious attention, require much more than a perfunctory application of chemistry and physics. The present relations of the minerals in the rocks are accessible to the microscope under convenient conditions of observation, but their development from the fluid magma requires a laboratory study of the rock-forming minerals over a wide range of measured conditions of pressure, temperature and concentration. It is of the first importance that the evidence gathered be quantitative and pertinent to the problem.

Recent laboratory studies have developed the fact that the temperature of crystallization of a mineral from its own liquid or from a mixture is generally variable and therefore untrustworthy in revealing the conditions of equilibrium during formation. Melting point measurements therefore furnish better determinations of the temperature of change of state. It is also necessary that the methods chosen for such determination be appropriate to the substance under investigation, for minerals are characterized by strong individuality of behavior near the melting temperature, which makes it impossible to apply a single property (the appearance of fluidity, for example) to determine when melting occurs in all substances. The lack of sharpness in melting point determinations is partly the result of carelessness in preparation of experimental conditions, partly of molecular inertia or viscosity which prevents any rapid rearrangement of the molecules of the liquid, and occasionally (in isomorphous mixtures) to changing composition during the change of state. The first of these can be eliminated; the second is characteristic of certain minerals and therefore a matter of record; the third is an essential feature of the problem requiring special study. The earlier melting point data offer little evidence upon which to discriminate between these cases. An important factor in rock formation is brought to light by the second of the properties noted above, of which an excellent illustration is found in quartz. In the laboratory, the fusion of pure silica does not occur below 1600° and is accompanied by conditions of extreme viscosity. In nature, vein quartz appears to have crystallized below 800° and to have been very fluid at that temperature. This suggests that volatile ingredients must have assisted in the formation of natural quartz of which only traces now remain, and its proper laboratory study must include these ingredients. The situation also reveals what is perhaps the chief function of pressure in rock formation—namely, in holding the volatile ingredients in solution.

Igneous Metamorphism: A. C. SPENCER.

Platinum in Southeastern Nevada: HOWLAND C. BANCROFT.

At the Key West and Great Eastern prospects in the Copper King Mining District of Clark County, Nev., platinum occurs in peridotite dikes of the enstatite-mica-picrite variety. The properties are situated in the rough foothills of the Virgin Range at an elevation of approximately 3,600 feet and are eight or nine miles from the Virgin River.

The rocks in the immediate vicinity are gneisses, probably of pre-Cambrian age, and are intruded along the planes of schistosity by basic dikes which contain, in addition to platinum, primary pyrrhotite (probably nickeliferous), magnetite, chalcopyrite and pyrite. Besides the peridotite dikes there is also present a typical hornblendite dike which shows upon analysis a trace of platinum. Alteration and concentration of the sulphides in the rock by solutions seems to increase the percentage of platinum and nickel, one analysis showing the presence of .55 of an ounce of platinum to the ton and over 5 per cent. nickel. The dikes as exposed upon the surface vary in width from 10 to 50 feet and are about 100 feet long.

One car-load of ore has been shipped from the Key West workings. If these properties were near a railroad, or if the ore could be treated on the ground, it is quite probable that they would be able to produce bullion. Under present conditions, however, working expenses would be very high.

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At the regular meeting held at the American Museum on February 14, 1910, Professor C. C. Curtis presiding, the following papers were read:

Variability of Land Snails (Cerion) in the Bahama Islands with its Bearing on the Theory of Geographical Form Chains: Charles B. Davenport.

Professor Plate has described, in the *Archiv f. Rassen- und Gesellschaftsbiol.*, Bd. IV., the different forms of a genus of land snails (*Cerion*) from the Bahama Islands; and declares that the *Cerions* of the north coast of New Providence constitute the best known and most known and most manifold example of such a morphologic-geographic "form chain" as the Sarasins describe. Going from the west to the east end of the island "regular and definitely directed changes" are said to occur "conditioned by the amount of precipitation together with an inner factor—a high responsiveness of the protoplasm."

In January, 1910, I collected shells in New Providence from the localities specified by Plate and from several others. I am now attempting to breed them. Meanwhile the evidence seems opposed to Plate's view, since the "western" type is found at various localities in the east alongside of the eastern type. The facts seem to accord better with the view of the immigration into the eastern end of New Providence of snails having the characteristics of *Cerions* from the Eleuthera Island (an immigration facilitated by geographic conditions) and by the formation of varied combinations of characters and pseudo-blends by hybridization.

Application of the Quadrate-incus Theory to the Conditions in Theridont Reptiles and the Genetic Relations of the Latter to the Mammalia: W. K. Gregory.

Reichert's conclusion that the incus and malleus of mammals represent the vestigial and metamorphosed jaw elements of lower vertebrates, together with the opposing view that these ossicles in the mammalia have been derived directly from the supra- and extra-stapedial cartilages of reptiles, were considered. Exception was taken to Dr. Broom's form of the latter theory, which took the auditory ossicles of the crocodile as a theoretical starting point. All the bones surrounding these elements in the crocodile had evidently undergone certain peculiar specializations and it would be surprising if the auditory ossicles themselves had not also suffered considerable modification in the endeavor to evolve an improved auditory apparatus; the resemblances in the ossicles between crocodile and mammal may therefore be due chiefly to convergent evolution. The modern upholders of the incus-quadrate, malleus-articular theory demand for the ancestral mammal a freely movable quadrate, similar to that of the lizard; but this was because they seem to push too far the biogenetic law. The incus or supposed homologue of the quadrate at present appears in the embryo as a freely movable bone, but this does not prove that it has always been freely movable. These investigators had passed by the theridonts of the Permian and Triassic because in these reptiles the quadrate was fixed at its upper end; but a slight atrophy of the posterior border of the squamosal would have greatly increased the mobility of the quadrate.

Paleontological and embryological evidence showed that the existing joint between the skull and the lower jaws in mammals is a neomorph, probably developed *pari passu* with the atrophy of the quadrate and articular bones. The application of Reichert's theory to the Theriodontia required only that the vestigial quadrate should be freed from its squamosal socket, and secondly that it and the articular should be brought into contact with the stapes or primary auditory rod. But how can we conceive an adaptive, mechanical motive for this extraordinary change? Such seems to be furnished by the embryology of the tympanic chamber of mammals. As is well known, this chamber appears below the ossicles as a diverticulum of the first gill opening. It grows upward and embraces the ossicles, which finally appear to be inside the cavity but are morphologically outside of it, since they never pierce its epithelium. So in the hypothetical pro-mammal the vestigial quadrate and articular on the one hand and the stapedial rod on the other may have been embraced by the up-growing tympanic sack or chamber and finally pressed into contact with each other. The vestigial jaw elements may thus have come to share in the vibrations of the chamber and of the stapes, and thus was initiated their career as accessory auditory ossicles. A somewhat analogous case is the transformation in siluroid fishes of certain vertebral appendages into a chain of ossicles for transmitting vibrations from the air bladder to the internal ear.

L. Hussakof